GE Healthcare

Corometrics™ 250 Series Monitor
Service Manual

Corometrics 250 Series Monitor
English
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Our obligation under this guarantee is limited to repairing, or, at our option, replacing any defective parts of our equipment, except fuses or batteries, without charge, if such defects occur in normal service.

Claims for damage in shipment should be filed promptly with the transportation company. All correspondence covering the instrument should specify the model and serial numbers.

GE MEDICAL SYSTEMS *Information Technologies*
A GE Healthcare Company

GE Medical Systems *Information Technologies* will make available on request such circuit diagrams, component diagrams, component parts lists, descriptions, calibration instructions, or other information which will assist the users or appropriately qualified technical personnel to repair those parts of the equipment which are classified by GE Medical Systems *Information Technologies* as repairable. Refer to the *250 Series Service Manual* for further information.

NOTE: In addition to software version 4.50, the information in this manual also applies to previous software revisions of Corometrics 250 Series Monitor. There are no user-apparent differences among these software versions. Due to continuing product innovation, specifications in this manual are subject to change without notice.

NOTE: For technical documentation purposes, the abbreviation GE is used for the legal entity name, GE Medical Systems *Information Technologies*

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Compliance

A GE brand Corometrics 250 Series Monitor bears CE mark CE-0086 indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfills the essential requirements of Annex I of this directive.

The device is manufactured in India; the CE mark is applied under the authority of Notified Body BSI (0086).

The country of manufacture and appropriate Notified Body can be found on the equipment labeling.

The product complies with the requirements of standard EN 60601-1-2 “Electromagnetic Compatibility—Medical Electrical Equipment” and standard EN 60601-1 “General Requirements for Safety.”

Components of the Certified Systems

The IEC electromagnetic compatibility (EN) standards require individual equipment (components and accessories) to be configured as a system for evaluation. For systems that include a number of different equipment that perform a number of functions, one of each type of equipment shall be included in the evaluation.

The equipment listed below is representative of all possible combinations. For individual equipment certification, refer to the appropriate declarations of conformity.

Component Description

- 250 Series Maternal/Fetal Monitor
- Model 146 Fetal Acoustic Stimulator
- Intrauterine Pressure Transducer
- FECG Cable/Legplate
- Ultrasound Transducers (x2)
- Blood Pressure Hose and Cuff
- MSpO_2 Interconnect Cable and Sensor
- MECG Cable
- FECG/MECG Adapter Cable
- Remote Event Marker
- RS-232C Interconnect Cables (x3)
- Central Nurses Station Interconnect Cable
- Model 2116B Keyboard and Interconnect Cable
- Model 1563AAO Telemetry Cable

Exceptions

None

Monitor System EMC: Immunity Performance

Be aware that adding accessories or components, or modifying the medical device or system may degrade the EMI performance. Consult with qualified personnel regarding changes to the system configuration.

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1 Introduction

Revision History

Each page of this manual has a revision letter located at the bottom of the page. This letter identifies the revision level of the entire manual. This may be important if you have different manuals and you do not know which is the most current.

For the initial release, all pages have the revision letter A. For the second update, all pages receive the revision letter B. The latest letter of the alphabet added to the table below corresponds to the most current revision.

Revision	Date	Comment
A	29-June-2005	Initial Release
B	16-September-2005	Add Gasket Top Cover FRU
C	21-March-2006	Update Nellcor changes
D	30-November-2006	Update front cover, T-2 page, add kPa mode, delete old accessory part numbers

For your notes

Safety Information

The information presented in this section is important for the safety of both the patient and operator. This chapter describes how the terms Danger, Warning, Caution, Important, and Note are used throughout the manual. In addition, standard equipment symbols are defined.

Responsibility of the Manufacturer

GE is responsible for the effects on safety, reliability, and performance if:

- assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by GE;
- the electrical installation of the relevant room complies with the requirements of appropriate regulations; and
- the monitor is used in accordance with the instructions of use.

Responsibility of the User

This device is intended for use by clinical professionals who are expected to know the medical procedures, practices, and terminology required to monitor obstetrical patients. This manual documents all possible parameters available in the 250 Series of monitors. It is the responsibility of each hospital to ensure that the Labor and Delivery staff is trained in all aspects of the selected model.

The 250 Series Monitor is designed to assist the perinatal staff by providing information regarding the clinical status of the mother and fetus during labor. The monitor does not replace observation and evaluation of the mother and fetus at regular intervals, by a qualified care provider, who will make diagnoses and decide on treatments or interventions. Visual assessment of the monitor display and strip chart must be combined with knowledge of patient history and risk factors to properly care for the mother and fetus.

References to Persons, Places, and Institutions

References to persons, places, and institutions used within this manual are solely intended to facilitate user comprehension of the 250 Series Monitor's use and functions. Extreme care has been taken to use fictitious names and related information in the examples and illustrations provided herein. Any similarity of this data to persons either living or dead and to either current or previously existing medical institutions should be regarded as coincidental.

Hazard Definitions

Six types of special notices are used throughout this manual. They are: Danger, Warning, Caution, Contraindication, Important, and Note. The warnings and cautions in this Safety section relate to the equipment in general and apply to all aspects of the monitor. Be sure to read the other chapters because there are additional warnings and cautions which relate to specific features of the monitor.

When grouped, warnings and cautions are listed alphabetically and do not imply any order of importance.

Definitions of Terminology	
Danger	A **DANGER** notice indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
Warning	A **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
Caution	A **CAUTION** indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. Cautions are also used to avoid damage to equipment.
Contraindication	A **CONTRAINDICATION** describes any special symptom or circumstance that renders the use of a remedy or the carrying out of a procedure inadvisable, usually because of a risk.
Important	An **IMPORTANT** notice indicates an emphasized note. It is something you should be particularly aware of; something not readily apparent.
Note	A **NOTE** indicates a particular point of information; something on which to focus your attention.

Product Specific Hazards

WARNINGS

ACCIDENTAL SPILLS—In the event that fluids are accidentally spilled on the monitor, take the monitor out of operation and inspect for damage.

APPLICATION—This monitor is not designed for direct cardiac connection.

CONDUCTIVE CONNECTIONS—Avoid making any conductive connections to applied parts (patient connection) which are likely to degrade safety.

CONDUCTIVE PARTS—Ensure that the conductive parts of the lead electrodes and associated connectors do not contact other conductive parts including earth.

CONNECTIONS—The correct way to connect a patient to the monitor is to plug the electrode leads into the patient cable which in turn connects to the monitor. The monitor is connected to the wall socket by the power cord. Do not plug the electrode leads into the power cord, a wall socket, or an extension cord.

DEFIBRILLATION—During defibrillation, all personnel must avoid contact with the patient and monitor to avoid a dangerous shock hazard. In addition, proper placement of the paddles in relation to the electrodes is required to minimize harm to the patient.

DEFIBRILLATION PROTECTION—When used with the GE Medical Systems *Information Technologies*-recommended accessories, the monitor is protected against the effects of defibrillator discharge. If monitoring is disrupted by the defibrillation, the monitor will recover.

ELECTRICAL SHOCK—To reduce the risk of electrical shock, do not remove monitor cover. Refer servicing to qualified personnel.

ELECTROMAGNETIC INTERFERENCE—Be aware that strong electromagnetic fields may interfere with monitor operation. Interference prevents the clear reception of signals by the monitor. If the hospital is close to a strong transmitter such as TV, AM or FM radio, police or fire stations, a HAM radio operator, an airport, or cellular phone, their signals could be picked up as monitor signals. If you feel interference is affecting the monitor, contact your Service Representative to check the monitor in your environment. Refer to Electromagnetic Interference on p. 1-7 for additional information.

WARNINGS

ELECTROSURGERY—The monitor is not designed for use with high-frequency surgical devices. In addition, measurements may be affected in the presence of strong electromagnetic sources such as electrosurgery equipment.

EXPLOSION HAZARD—Do not use this equipment in the presence of flammable anesthetics or inside an oxygen tent.

GROUNDING—Do not defeat the three-wire grounding feature of the power cord by means of adaptors, plug modifications, or other methods. A dangerous shock hazard to both patient and operator may result.

INOPERABLE MECG—The MECG trace is not visible during a LEADS OFF condition or an overload (saturation) of the front-end amplifier during differential input voltage of more than ±300mV.

INSTRUCTIONS—For continued and safe use of this equipment, it is necessary to follow all listed instructions. However, the instructions provided in this manual in no way supersede established medical procedures concerning patient care. The monitor does not replace observation and evaluation of the patient, at regular intervals, by a qualified care provider who will make diagnoses and decide on treatments and interventions.

INTERFACING OTHER EQUIPMENT—Monitoring equipment must be interfaced with other types of medical equipment by qualified biomedical engineering personnel. Be certain to consult manufacturers' specifications to maintain safe operation.

LEAKAGE CURRENT TEST—The interconnection of auxiliary equipment with this device may increase the total leakage current. When interfacing with other equipment, a test for leakage current must be performed by qualified biomedical engineering personnel before using with patients. Serious injury or death could result if the leakage current exceeds applicable standards. The use of accessory equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system. Consideration relating to the choice shall include: use of the accessory in the patient vicinity; and evidence that the safety certification of the accessory has been performed in accordance with the appropriate EN60601.1 and/or EN60601.1.1 harmonized national standard.

WARNINGS

LINE ISOLATION MONITOR TRANSIENTS—Line isolation monitor transients may resemble actual cardiac waveforms, and thus cause incorrect heart rate determinations and alarm activation (or inhibition).

MRI USE—Do not use the electrodes during MRI scanning; conducted current could potentially cause burns.

PATIENT CABLES AND LEADWIRES—Do not use patient cables and electrode leads that permit direct connection to electrical sources. Use only "safety" cables and leadwires. Use of non-safety patient cables and leadwires creates risk of inappropriate electrical connection which may cause patient shock or death.

PACEMAKER PATIENTS—Rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon rate meter alarms. Keep pacemaker patients under close surveillance. Refer to "Appendix A, Technical Specifications" for disclosure of the pacemaker pulse rejection capability of the 250 Series Monitor.

RF INTERFACE—Known RF sources, such as cell phones, radio or TV stations, and two-way radios, may cause unexpected or adverse operation of this device.

SIMULTANEOUS DEVICES—Do not simultaneously connect more than one device that uses electrodes to detect ECG and/or respiration to the same patient. Use of more than one device in this manner may cause improper operation of one or more of the devices.

STRANGULATION—Make sure all patient cables, leadwires, and tubing are positioned away from the patient's head to minimize the risk of accidental strangulation.

WATER BIRTHS—Do not use the monitor to directly monitor patients during water births, in whirlpool or submersion water baths, during showers, or in any other situation where the mother is immersed in water. Doing so may result in electrical shock hazard.

Cautions

CAUTIONS

ANNUAL SERVICING—For continued safety and performance of the monitor, verify the calibration, accuracy, and electrical safety of the monitor annually. Contact your GE Medical Systems *Information Technologies* Service Representative.

DAILY TESTING—It is essential that the monitor and accessories be inspected every day. It is recommended practice to initiate the monitor's self-test feature at the beginning of each monitoring session; follow the instructions in "Chapter 5, Setup Procedures".

ENVIRONMENT—The performance of the monitor has not been tested in certain areas, such as x-ray and imaging suites. The monitor is not recommended for use in these environments.

EQUIPMENT CONFIGURATION—The equipment or system should not be used adjacent to, or stacked with, other equipment. If adjacent or stacked use is necessary, the equipment or system should be tested to verify normal operation in the configuration in which it is being used.

PERFORMANCE—Report all problems experienced with the monitor. If the monitor is not working properly, contact your Service Representative for service. The monitor should not be used if it is not working properly.

PINCHING—Keep fingers clear of the paper roller because the roller could pinch your fingers.

STATIC ELECTRICITY—This assembly is extremely static sensitive and should be handled using electrostatic discharge precautions.

TRAPPING—Keep hands, hair, jewelry, and loose clothing away from the paper roller because the roller could trap these items.

TRIPPING—Arrange monitoring equipment so that cords and cables do not present a tripping hazard.

Electromagnetic Interference

This device has been tested and found to comply with the limits for medical devices to the IEC 601-1-2:1993, EN60601-1-2:2001, Medical Device Directive 93/42/EEC. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation.

However, because of the proliferation of radio-frequency transmitting equipment and other sources of electrical noise in the health-care and home environments (for example, cellular phones, mobile two-way radios, electrical appliances), it is possible that high levels of such interference due to close proximity or strength of a source, may result in disruption of performance of this device.

Refer to the Electromagnetic Immunity information in this product's service manual for EN 60601-1-2 (2001) Edition 2 compliance information and safety information for this product.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference with other devices in the vicinity. Disruption or interference may be evidences by erratic readings, cessation of operation, or incorrect functioning. If this occurs, the site of use should be surveyed to determine the source of this disruption, and actions taken to eliminate the source.

The user is encouraged to try to correct the interference by one or more of the following measures:

- Turn equipment in the vicinity off and on to isolate the offending equipment.
- Reorient or relocate the other receiving device.
- Increase the separation between the interfering equipment and this equipment.
- If assistance is required, contact your GE Medical Systems *Information Technologies* Service Representative.

Equipment Symbols

The following is a list of symbols used on products manufactured by GE. Some symbols may not appear on your unit.

Equipment Symbols	
	ATTENTION: Consult accompanying documents.
	This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact the manufacturer or other authorized disposal company to decommission your equipment.
	TYPE B EQUIPMENT. Type B equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application.
	TYPE BF EQUIPMENT. Type BF equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application. Type BF equipment has an F-type applied part.
	DEFIBRILLATOR-PROOF TYPE BF EQUIPMENT: Type BF equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application. Type BF equipment is type B equipment with an F-type isolated (floating) part. The paddles indicate the equipment is defibrillator proof.
	TYPE CF EQUIPMENT. Type CF equipment is suitable for intentional external and internal application to the patient including direct cardiac application. Type CF equipment is F-type applied part that provides a higher degree of protection against electric shock than that provided by Type BF applied parts.
	ALTERNATING CURRENT (AC).
	EQUIPOTENTIALITY.
O	POWER OFF: disconnection from the mains.
I	POWER ON: connection to the mains.

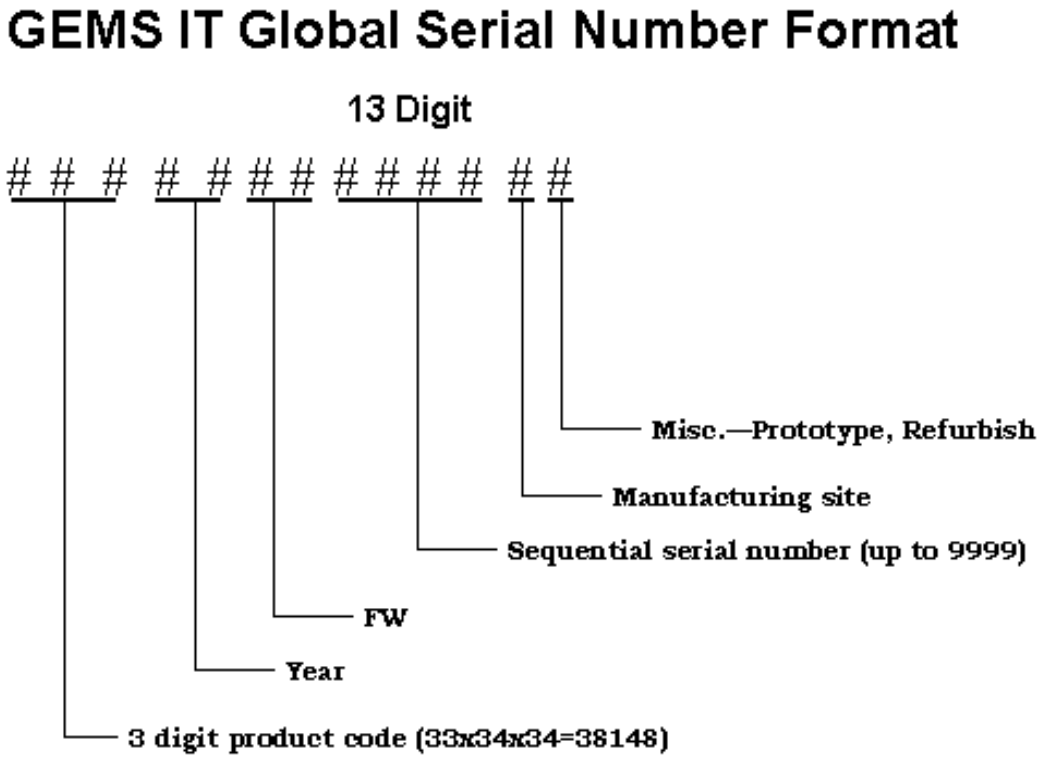
Service Requirements

Follow the service requirements listed below.

- Refer equipment servicing to GE Medical Systems *Information Technologies* authorized service personnel only.
- Any unauthorized attempt to repair equipment under warranty voids that warranty.
- It is the user's responsibility to report the need for service to GE Medical Systems *Information Technologies* or to one of GE's authorized agents.
- Failure on the part of the responsible individual, hospital or institution using this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.
- Regular maintenance, irrespective of usage, is essential to ensure that the equipment will always be functional when required.

Equipment ID

The following graphic illustrates the components of the monitor's serial number.


GEMS IT Global Serial Number Format
13 Digit
# # # # # # # # # # # #
Misc.—Prototype, Refurbish
Manufacturing site
Sequential serial number (up to 9999)
FW
Year
3 digit product code (33x34x34=38148)

Global Serial Number Format

Intended Audience

This manual is intended for trained service professionals.

Intended Use

General Use

If the monitor is cold to the touch or below ambient temperature, allow it to reach ambient, room temperature before use.

To ensure patient safety, use only parts and accessories manufactured or recommended by GE Medical Systems *Information Technologies*. Parts and accessories used shall meet the requirements of EN60601.1.1.

Disposable devices are intended for single use only. They should not be reused.

Periodically, and whenever the integrity of the monitor is in doubt, test all functions. Refer to "Checkout" on page 4-19.

Refer to the "Maternal/Fetal Monitoring, Clinical Applications Manual" for information concerning the limitations of internal and external fetal heart rate monitoring techniques.

Fetal Monitoring

A Corometrics 250 Series Monitor can be used for routine non-invasive and invasive fetal monitoring throughout labor and delivery (i.e., fetal heart rate and uterine activity monitoring). Fetal movement detection and Spectra Alerts are options that may be purchased.

Maternal Monitoring

A Corometrics 250 Series Maternal/Fetal Monitor is intended for monitoring maternal vital signs to help assess maternal well-being. The vital signs which can be measured with either of these monitors are summarized below.

Blood Pressure

This parameter is intended for use in the non-invasive monitoring of maternal blood pressure (NIBP). This monitor is not intended for use in neonatal or pediatric blood pressure monitoring.

Pulse Oximetry

This parameter is intended for use in the non-invasive monitoring of the functional oxygen saturation of maternal arterial blood ($MSpO_2$).

Heart/Pulse Rate

This parameter is intended for use in the non-invasive monitoring of the maternal heart/pulse rate (MHR/P).

Related Manuals

Manual	Title
2020550-001	250 Series Operator's Manual
15457	Maternal/Fetal Monitoring, Clinical Application
2004435-001	Information For Prescribers

2 Equipment Overview

For your notes

Equipment Description

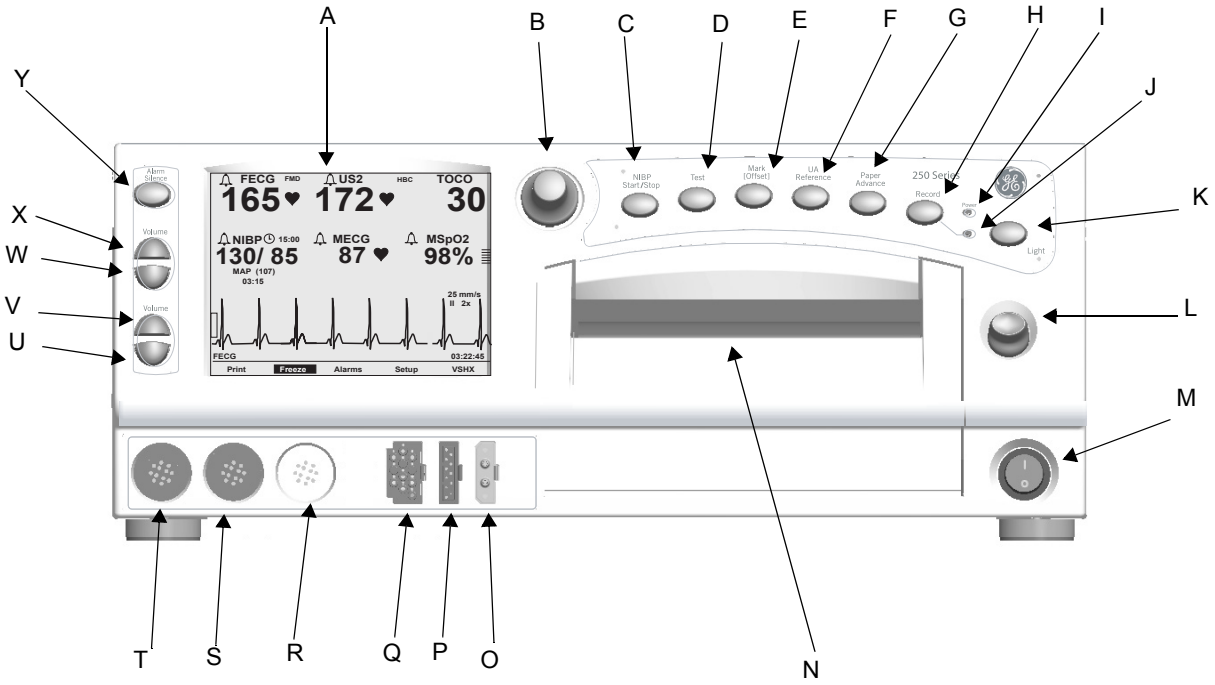
The 250 Series Fetal Model monitors two Fetal Heart Rate channels plus Uterine Activity (TOCO or IUP).

The 250 Series Maternal/Fetal Model monitors maternal NIBP, SpO_2 and MECG, in addition to the features found in the Fetal Model.

A feature summary follows:

Fetal Only Monitor	Maternal/Fetal Monitor
■ US	■ US
■ US2	■ US2
■ FECG	■ FECG
■ TOCO	■ TOCO
■ IUP	■ IUP
	■ NIBP
	■ $MSpO_2$
	■ MECG

Front Panel Description



Monitor Front

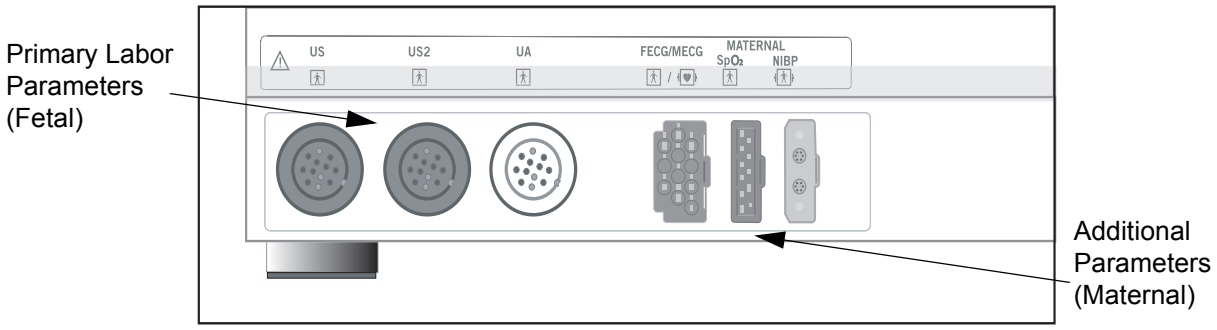
Table 1. Front Panel		
#	**Name**	**Description**
A	Display	The monitor's display is divided into several sections. The content and layout of the display can change, depending on which functions are installed in the monitor and the modes of operation in use.
B	Trim Knob Control	Operation of the monitor is controlled by using the front panel buttons in conjunction with the Trim Knob control. This control selects softkeys on the display and positions a cursor within a setup screen. Rotate the Trim Knob control left or right to highlight items on the screen with a bar cursor. After highlighting the desired item, press the Trim Knob control to make the selection. In summary: rotate to move cursor; press to select an item.
C	**NIBP Start/Stop** Button	This button starts and stops both manual and automatic blood pressure determinations. It also provides a "shortcut" for changing the auto interval time.
D	**Test** Button	Pressing this button starts or stops a monitor self-test routine.

Table 1. Front Panel		
#	**Name**	**Description**
E	**Mark [Offset]** Button	The **Mark [Offset]** button is a multi-function button. ■ Mark: Pressing this button prints an event mark ↑ on strip chart paper (on the bottom two lines of the top grid). ■ Offset: When the Heart Rate Offset mode is enabled, pressing and *holding* this button shifts the secondary FHR trend +20 bpm for visibility purposes.
F	**UA Reference** Button	The **UA Reference** button sets a baseline for uterine activity pressure monitoring.
G	**Paper Advance** Button	Pressing this button advances chart paper at a rate of 40 cm/min for as long as the button is held down.
H	**Record** Button	The **Record** button selects one of three recorder states: on, maternal-only mode, or off.
I	**Power** Indicator	The indicator lights green when the monitor is turned on.
J	Record Indicator	**Indicator Status** / **Recorder Status** on / on off / off three short flashes every 5 sec / maternal-only mode flashes on and off / error condition
K	**Light** Button	Illuminates the strip chart paper for night time visibility.
L	Recorder Door Latch	Opens the strip chart recorder door to add, remove, or adjust the paper.
M	Power Switch	Moving the switch to the *on* position (**I**) turns on the monitor; moving the switch to the *off* position (**O**) turns off the monitor.
N	Strip Chart Recorder	Annotations and trends are printed on the strip chart paper. Two paper styles are available.
O	**Maternal NIBP** Connector	Connect a pneumatic hose and blood pressure cuff assembly to this black twin lumen connector.
P	**Maternal SpO_2** Connector	Connect a 250 Series MSpO_2 intermediate cable to this royal blue connector. Use only Nellcor Maternal Oxygen Saturation Sensors if Nellcor technology is installed in your monitor, Masimo Sensors if Masimo technology is installed in your monitor, or Ohmeda Sensors if Ohmeda technology is installed in the monitor.
Q	**FECG/MECG** Connector	Connect an FECG cable/legplate or MECG cable plug to the **FECG/MECG** connector. Cables with *rectangular* plugs connect directly to the **FECG/MECG** connector. Cables with *round* plugs require an FECG/MECG adapter. This adapter is used for dual ECG monitoring as well. The adapter branches into two cables, each with a *round* connector at the end: one branch is labeled **MECG**; the other branch is labeled **FECG**.
R	**UA** Connector	Connect a tocotransducer, IUPC, or strain gauge transducer plug to this white connector. Contact your Sales Representative for information about compatibility.
S	**US2** Connector	Connect the secondary ultrasound transducer plug to this light gray connector.
T	**US** Connector	Connect the primary ultrasound transducer plug to this light gray connector.

Table 1. Front Panel		
#	**Name**	**Description**
U	FHR2 **Volume** Decrease Button	The four **Volume** buttons raise (△) and lower (▽) the volume of sound emitted by the rear panel speaker. The upper pair controls the volume for FHR1. The lower pair controls the volume for FHR2. Volume settings have no effect on the processing used to determine heart rate. The **Volume** buttons work in conjunction with the volume control settings on the *US/US2 Setup* screen and on the *FECG Setup* screen.
V	FHR2 **Volume** Increase Button	
W	FHR1 **Volume** Decrease Button	
X	FHR1 **Volume** Increase Button	
Y	**Alarm Silence** Button	Pressing this button silences the audible indication of an individual alarm. (Refer to Re-Alarm in the “Alarms” Section for more information.)

Front Panel Displays

The monitor is divided into two main sections: patient information (the left-side of the monitor) and monitor functionality (the right-side of the monitor). The keys are ordered for user efficiency.The content and layout of the display can change, depending on which functions are installed in the monitor and the modes of operation in use.



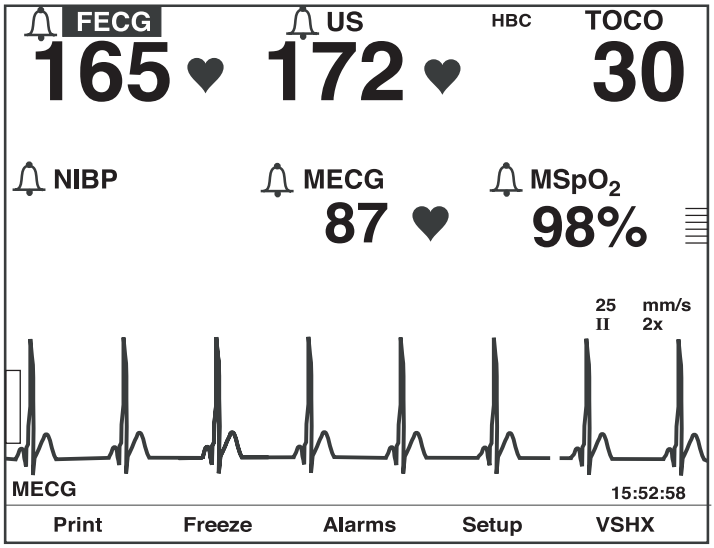
Maternal and Fetal Parameters

Table 2. Display Summary		
Display Section	**Item**	**Mode**
Primary Labor Parameters (upper portion of monitor)	Fetal Heart Rate 1 (FHR1)	*US, US2, FECG,* or *INOP*
	Fetal Heart Rate 2 (FHR2)	*US, US2,* or *INOP*
	Uterine Activity (UA)	*TOCO, IUP,* or *INOP*
Additional Parameters (Available in Maternal/Fetal Monitor only)	Maternal Blood Pressure	*NIBP*
	Maternal Heart/Pulse Rate	*MECG, Pulse* or *INOP*
	Maternal SpO_2	*MSpO*$_2$
Waveform	Fetal ECG Waveform, Maternal ECG Waveform, or Maternal SpO_2 Pulsatile Waveform	*FECG, MECG, MSpO*$_2$, or *Off*
Time	Current Time, [Label] *Frozen* Message and Time of Activation	—
Softkeys	System Configuration Softkey Controls	—

Display Example

From the graphic below, you can determine the following:

- Blood pressure is not active as indicated by the absence of numerics.
- Maternal pulse oximetry is active by presence of pulse amplitude indicator.
- *MECG* is selected as the heart rate source as indicated by the *MECG* mode title softkey—rather than *Pulse*.
- The MECG waveform is displayed at *25 mm/sec*, at a size of *2x*, with lead *II* selected.
- Heartbeat coincidence is enabled as indicated by the *HBC* acronym in the primary labor parameters area.
- All alarms are enabled as indicated by 🔔.



Maternal/Fetal Monitor Display Example

Setup Screens

Review Chapters 3 and 4 of the *Corometrics 250 Series Operator's Manual* for information on the individual parameters and setup screens.

Softkeys

A softkey is an area on the screen that can be selected with the Trim Knob control. When the softkey is activated by pressing the Trim Knob control, it may cycle through available settings or it may display a setup screen.

Mode Title Softkeys

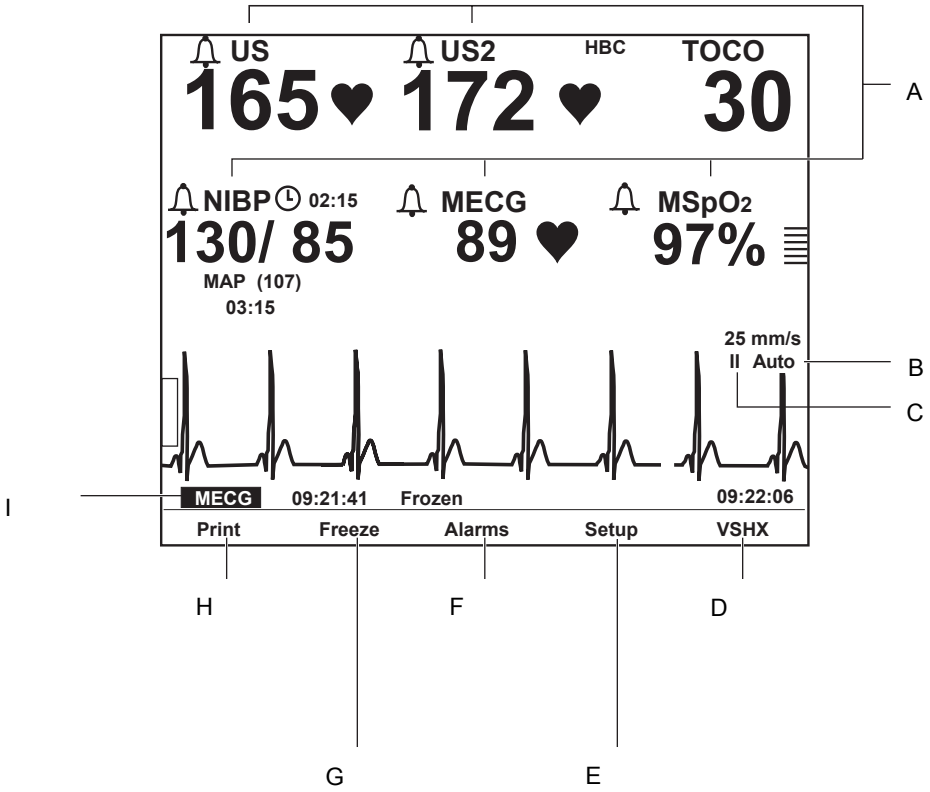
Most of the mode titles in the display are also softkeys which give access to corresponding setup screens: *US*, *US2*, *FECG*, *NIBP*, *MECG*, *Pulse*, and *MSpO$_2$*.

Waveform Softkeys

The waveform title is a softkey used to select the waveform for display or to disable the area. The ECG *Scaling* and *MECG lead* labels are softkeys used to configure the waveform currently displayed.

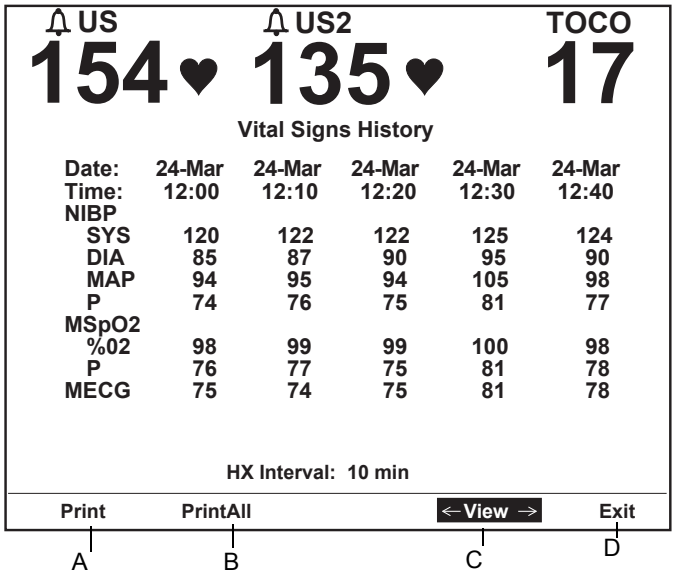
Dedicated Softkey Area

Softkeys are located at the bottom of each screen. Although there are many possible softkeys which may appear in this area, a maximum of five are shown at a time.



Maternal/Fetal Monitor Display Summary

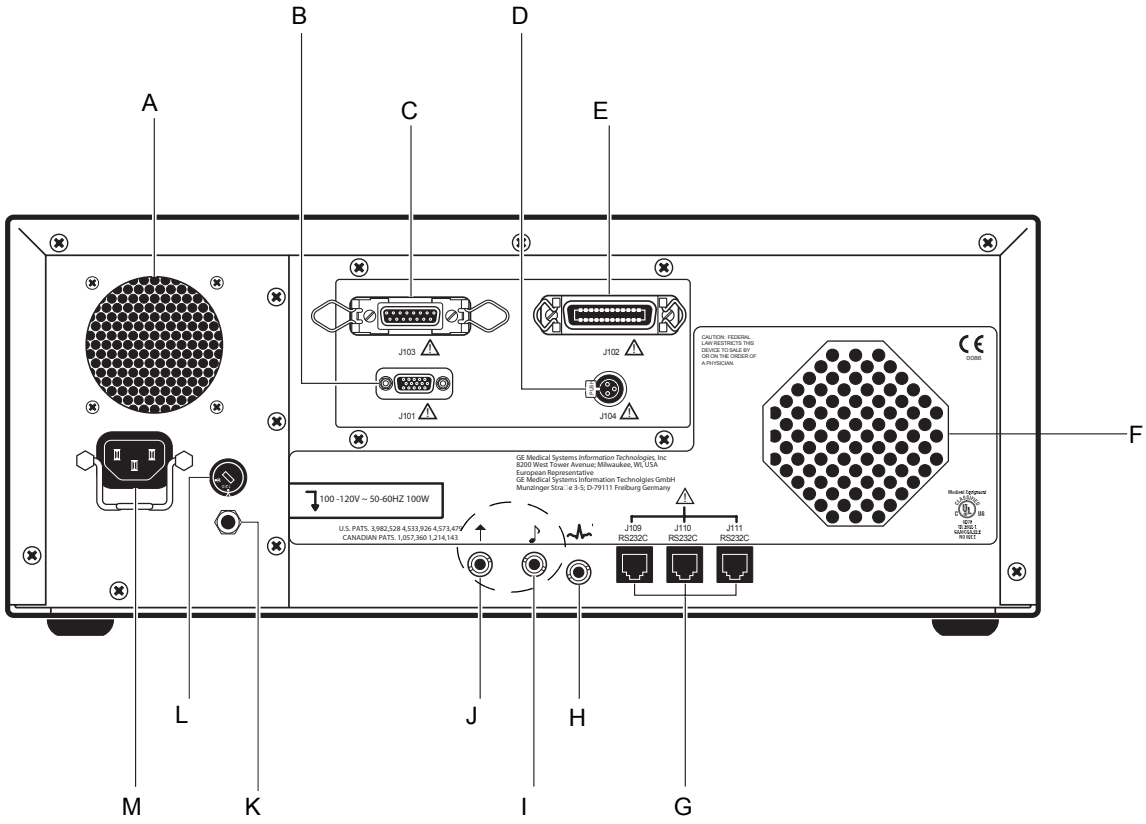
Table 3. Display Summary		
	Name	**Description**
A	Mode Title Softkeys	Selects *US, US2, FECG, NIBP, MHR/P,* or *$MSpO_2$ Setup* screens.
B	ECG Scale Softkey	Selects *0.25x, 0.5x, 1x, 2x, 4x, or Auto*.
C	MECG Lead Softkey	Selects Lead *I, II,* or *III*.
D	*VSHX* Softkey	Displays maternal Vital Signs History screen. (See illustration below.)
E	*Setup* Softkey	Displays *General Setup* screen
F	*Alarms* Softkey	Displays *Master Alarm Setup* screen.
G	*Freeze* Softkey	Freezes waveform for analysis; unfreezes waveform to return to real-time display.
H	*Print* Softkey	Prints 6-second snapshot of frozen waveform, real-time waveform, or maternal vital signs history.
I	Waveform Softkey	Selects *FECG, MECG, $MSpO_2$,* or *Off*.



I Maternal Vital Signs History Screen Softkeys

Table 4. Maternal Vital Signs History Screen Softkeys		
	Name	**Description**
A	*Print* Softkey	Prints one page (screen) of the table.
B	*PrintAll* Softkey	Prints all pages (screens).
C	*View* Softkey	Scrolls through the data: ■ Counterclockwise for newest data ■ Clockwise for oldest data
D	*Exit* Softkey	Returns to the previous screen.

Rear Panel Description



Monitor Rear Panel Connectors (Standard and Optional)

IMPORTANT: The Fetal Acoustic Stimulator and Remote Event Marker connectors are identical in size and shape. Be sure you connect to the proper connector to ensure accurate information.

Table 5. 250 Series Rear Panel (Standard and Optional Features)		
	Name	**Description**
A	Vent	Provides ventilation for the monitor's internal circuitry.
B	**J101** Telemetry Connector	Connector for Corometrics 340 telemetry system interface.
C	**J103** Data Entry Connector	Connector for data entry system interface.
D	**J104** Nurse Call Connector	Connector for standard Nurse Call System interface. The connector's maximum output is 50 Vdc at 100 mA; the maximum on resistance is 0.5 Ω.
E	**J102** Central Systems Connector	Connector for analog central station system interface.

Table 5. 250 Series Rear Panel (Standard and Optional Features)		
	Name	**Description**
F	Speaker	The rear panel speaker emits an audible tone for heart rates, $MSpO_2$ pulse with $\%O_2$-dependent pitch, and alarms. It also provides the sound for the song player feature.
G	**J109, J110, and J111 RS-232C** Communications Connectors	Three serial RJ-11 connectors are provided for interfacing to peripheral equipment. Contact your GE Service Representative for more information.
H	**ECG Out** Connector	External recorder connector for MECG signals. The standard output level is 1 V/mV.
I	Fetal Acoustic Stimulator Connector	Connector for Corometrics Model 146 Fetal Acoustic Stimulator (FAST). A musical note symbol prints on the strip chart paper each time the Model 146 is used: ♪
J	Remote Event Marker Connector	Connector for the Corometrics Remote Event Marker. When activated, one of the following marks prints on the strip chart paper: ■ The event marker is commonly used to record an "event": ↑ ■ The fetal movement marker (default setting) is commonly used as an indication that the mother has perceived fetal movement: FM↑ Refer to the "Coro 250 Series Monitor Service Manual" for more information.
K	Equipotential Lug	A binding post terminal is directly connected to the chassis for use as an equipotentiality connection.
L	AC Voltage Selection Switch	This switch is intended for qualified service personnel to select a voltage range for the AC input: ■ **120:** Accepts an AC input in the range of 100–120 VAC. ■ **240:** Accepts an AC input in the range of 220–240 VAC
M	Power Entry Module	AC line power cord connector. Refer to the rear panel markings to verify line voltage and line frequency requirements.

CAUTION

NON-DESTRUCTIVE VOLTAGE—The maximum non-destructive voltage that may be applied to the rear panel connectors is 0 volts. Do not attempt to connect cables to these connectors without contacting your Biomedical Engineering Department or GE Medical Systems *Information Technologies* Service Representative. This is to ensure the connectors comply with leakage-current requirements of one of the following applicable standards: Underwriters Laboratories UL-2601-1, Canadian Standards Associations CSA 22.2 No. 125, or International Electrotechnical Commission EN60601-1.

Optional Components

Software Upgrades

To install a purchased option, a software utility program uses one of the monitor's RS-232 serial ports. Each upgrade CD contains the software upgrade. The instructions for running the upgrade are on the CD. Refer to Chapter 6, "Parts List, Drawings, and Replacement" to order a kit.

Adding Spectra Alerts

The monitor can be upgraded to include Spectra Alerts. Refer to Appendix D of the *Corometrics 250 Series Operator's Manual* for more information.

Adding Fetal Movement Detection

The monitor may be upgraded to include Fetal Movement Detection. Contact your GE Service Representative for further information.

Peripheral Components

Nellcor® Puritan Bennett Model N-200 Maternal Pulse Oximeter

Through this interface, $MSpO_2$ readings provided by an NPB Model N-200 are printed at selected intervals on the strip chart paper of the 250 Series Monitor.

When the recorder is on, each reading is printed in the annotation area between the top and bottom grids. A filled diamond marker, above the data, marks the time of the reading and identifies the data source as an external device. The following is an example annotation:

♦
$MSpO_2$ 97% P 78

When the recorder is in maternal-only mode, a time stamp and filled diamond mark precede each reading. A sample annotation looks like this:

11:13 ♦ $MSpO_2$ 97% P 78

To connect the Model N-200:

1. Using interface cable, connect one end to an available **RS-232C** port (**J109** or **J111** only) on the 250 Series Monitor; connect the other end to the **Serial Communications** port on the pulse oximeter.
2. Access the Communications Setup service mode screen and set the mode to Nellcor for the appropriate port. Using the manufacturer's instructions for use for

the external monitor, determine the baudrate setting for the 250 Series monitor. Then exit the service mode screens.

3. Access the *General Setup* screen and choose the time interval for printing the $MSpO_2$ values on the strip chart paper. Refer to "Setup" on page 3-9 for more detailed information.
4. Ensure the NPB N-200 is set to the Beat-to-Beat mode.

Nellcor Puritan Bennett Model N-400 Fetal Pulse Oximeter

NOTE: The Model N-400 monitor is not available in all countries.

Through this interface, $FSpO_2$ readings provided by an NPB Model N-400 are printed at selected intervals on the strip chart paper of the 250 Series Monitor.

When the recorder is on, each reading is printed in the annotation area between the top and bottom grids. A filled diamond marker, above the measured values, marks the time of the reading and identifies the data source as an external device. The following is an example annotation:

♦
$FSpO_2$ 45%

In addition, the $FSpO_2$ trend can be optionally printed on the bottom grid of the strip chart paper; the trend is printed as a beaded trace (—▪—).

NOTE: Your Nellcor N-400 must be at software version 4.2.0.02 or later. Consult your Nellcor product documentation, or contact your Nellcor representative if you are not certain of the version.

To connect the Model N-400:

1. Using interface cable, connect one end to an available **RS-232C** port (**J109, J110**, or **J111**) on the 250 Series Monitor; connect the other end to the **Serial Communications** port on the pulse oximeter.
2. Access the *Communications Setup* service mode screen and set the mode to Nellcor for the appropriate port. Using the manufacturer's instructions for use for the external monitor, determine the baudrate setting for the 250 Series monitor. Then exit the service mode screens.
3. Access the *General Setup* screen, then: choose the time interval for printing the $FSpO_2$ values on the strip chart paper; and enable/disable trending of $FSpO_2$ on the bottom grid of the strip chart paper. Refer to "Setup" on page 3-9 for more information.
4. Ensure the NPB N-400 is set to the Beat-to-Beat mode.

DINAMAP® Models PRO Series 100-400 and ProCare

All of the above DINAMAP Monitors can be interfaced to a 250 Series Monitor to provide a printout of NIBP values on the strip chart paper.

ILC-1926

An ILC-1926 is required to interface with the DINAMAP PRO Series and ProCare Monitors.

Quantitative Sentinel/Perinatal System

Through this interface, the 250 Series Monitor outputs MHR data, FHR data, and UA data to a central information such as a Quantitative Sentinel/Perinatal System. Annotations made at the central station can be optionally printed on the strip chart paper of the 250 Series Monitor as summarized below (if the central station has the capability to send the command):

- Each message is preceded by a computer icon ( ).
- Messages are restricted to a maximum length of 50 characters.
- Lower-case letters are converted to upper-case letters.
- Non-standard characters are replaced with spaces.

The 250 Series Monitor can be configured with the remote annotation capability enabled (*1371/Notes* mode) or disabled (*1371* mode). The following is an example of a remote message sent to a 250 Series Monitor from a central information system using this serial communications protocol.

<SPW> AVERAGE VARIABILITY

To connect a central information system:

1. Obtain an appropriate interface cable: connect one end to an available **RS-232C** connector (**J109, J110,** or **J111**) on the 250 Series Monitor; connect the other end to the wallplate wired to the central information system. For a Quantitative Sentinel/Perinatal System: the interface cable is catalog number (REF) 1558AAO (10') or 1558BAO (20'); the corresponding wallplate connector is labeled **RS-232 COMMUNICATIONS**.
2. Access the Communications Setup service mode screen and set the baudrate and mode for the appropriate port to 1200 bps and either the *1371* or *1371/Notes* mode, respectively; then exit the service mode screens.

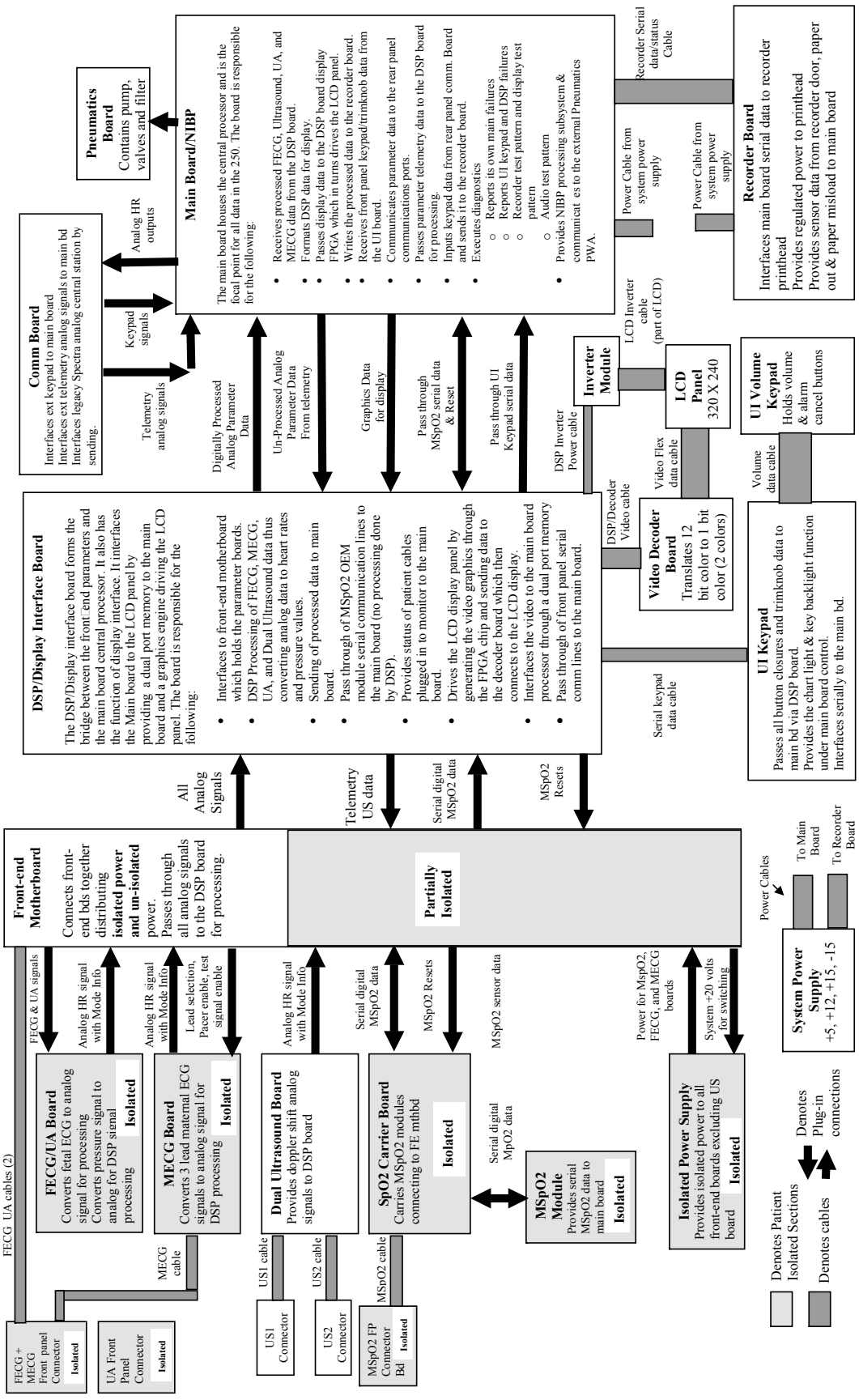
Table 6. External Device Summary					
External Device	**Parameter(s)**	**250 Series Baudrate**	**Interconnect Cable Cat. No.**		**Communications Protocol**
			1 ft	**6 ft**	
Nellcor® Model N-200	$MSpO_2$	Refer to applicable manufacturer's instructions for use	1557AAO	1557BAO	*Nellcor*
DINAMAP® PRO 400	NIBP		1562AAO	1562BAO	*Critikon*
DINAMAP® ProCare	NIBP, $MSpO_2$		**10 ft**	**20 ft**	
Quantitative Sentinel System	Annotations (optional)		1558AAO	1558BAO	*1371* or *1371/Notes*

Theory of Operation

Systems Overview

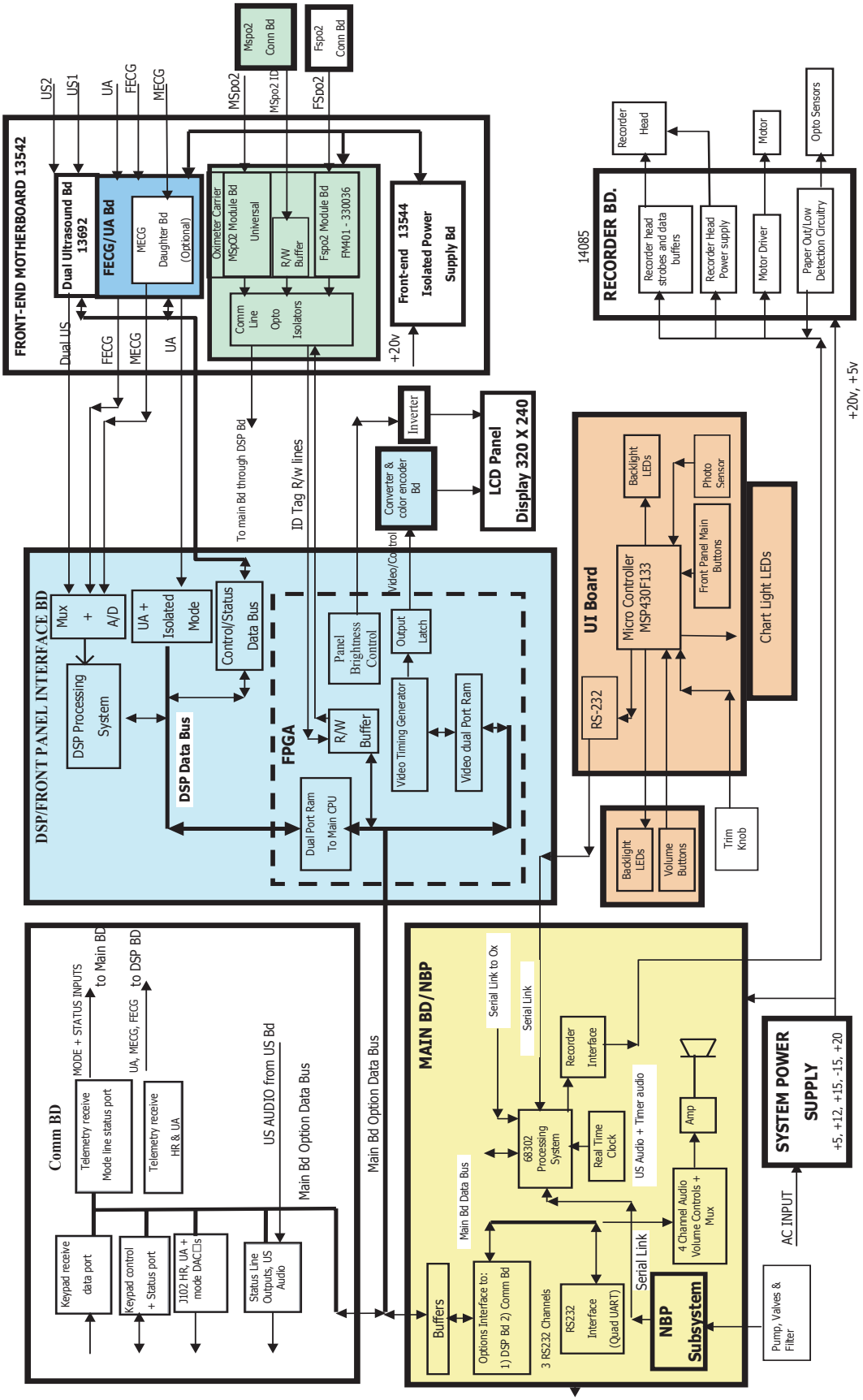
The 250 Series system is made up of front-end and back-end PWAs, system power supply, and recorder module. The main PWA forms the heart of the monitor control functions. This PWA along with the Communications PWA form the back end of the monitor. The DSP/Display PWA is the bridge between the front-end and back end sections. The front-end PWAs are housed in the sealed front-end card cage and consist of isolated and un-isolated PWAs. The recorder assembly houses the recorder PWA.

The basic block diagram below shows all of the PWAs and external parts as well as their internal block functions. The block diagram description on the following page attempts to show all of the PWAs and parts, how they are connected (cable or direct plug-in), the areas of isolation (PWAs and cables), and a brief theory of operation for a quick total system overview.


Comm Board
Interfaces ext keypad to main board
Interfaces ext telemetry analog signals to main bd
Interfaces legacy Spectra analog central station by sending.
Keypad signals
Telemetry analog signals
Analog HR outputs
Pneumatics Board
Contains pump, valves and filter
Main Board/NIBP
The main board houses the central processor and is the focal point for all data in the 250. The board is responsible for the following:
Receives processed FECG, Ultrasound, UA, and MECG data from the DSP board.
Formats DSP data for display.
Passes display data to the DSP board display FPGA which in turns drives the LCD panel.
Writes the processed data to the recorder board.
Receives front panel keypad/trimknob data from the UI board.
Communicates parameter data to the rear panel communications ports.
Passes parameter telemetry data to the DSP board for processing.
Inputs keypad data from rear panel comm. Board and sends it to the recorder board.
Executes diagnostics
Reports its own main failures
Reports UI keypad and DSP failures
Recorder test pattern and display test pattern
Audio test pattern
Provides NIBP processing subsystem & communicat es to the external Pneumatics PWA.
Power Cable from system power supply
Power Cable from system power supply
Recorder Serial data/status Cable
Recorder Board
Interfaces main board serial data to recorder printhead
Provides regulated power to printhead
Provides sensor data from recorder door, paper out & paper misload to main board
Digitally Processed Analog Parameter Data
Un-Processed Analog Parameter Data From telemetry
Graphics Data for display
Pass through MSpO2 serial data & Reset
Pass through UI Keypad serial data
DSP/Display Interface Board
The DSP/Display interface board forms the bridge between the front end parameters and the main board central processor. It also has the function of display interface. It interfaces the Main board to the LCD panel by providing a dual port memory to the main board and a graphics engine driving the LCD panel. The board is responsible for the following:
Interfaces to front-end motherboard which holds the parameter boards.
DSP Processing of FECG, MECG, UA, and Dual Ultrasound data thus converting analog data to heart rates and pressure values.
Sending of processed data to main board.
Pass through of MSpO2 OEM module serial communication lines to the main board (no processing done by DSP).
Provides status of patient cables plugged in to monitor to the main board.
Drives the LCD display panel by generating the video graphics through the FPGA chip and sending data to the decoder board which then connects to the LCD display.
Interfaces the video to the main board processor through a dual port memory
Pass through of front panel serial comm lines to the main board.
Inverter Module
LCD Inverter cable (part of LCD)
LCD Panel 320 X 240
UI Volume Keypad
Holds volume & alarm cancel buttons
DSP Inverter Power cable
DSP/Decoder Video cable
Video Flex data cable
Volume data cable
Video Decoder Board
Translates 12 bit color to 1 bit color (2 colors)
UI Keypad
Passes all button closures and trimknob data to main bd via DSP board.
Provides the chart light & key backlight function under main board control.
Interfaces serially to the main bd.
Serial keypad data cable
All Analog Signals
Telemetry US data
Serial digital MSpO2 data
MSpO2 Resets
Front-end Motherboard
Connects front-end bds together distributing isolated power and un-isolated power.
Passes through all analog signals to the DSP board for processing.
Partially Isolated
Power Cables
To Main Board
To Recorder Board
System Power Supply
+5, +12, +15, -15
FECG & UA signals
Analog HR signal with Mode Info
Analog HR signal with Mode Info
Lead selection, Pacer enable, test signal enable
Analog HR signal with Mode Info
Serial digital MSpO2 data
MSpO2 Resets
MSpO2 sensor data
Power for MSpO2, FECG, and MECG boards
System +20 volts for switching
FECG/UA Board
Converts fetal ECG to analog signal for processing
Converts pressure signal to analog for DSP signal processing
Isolated
MECG Board
Converts 3 lead maternal ECG signals to analog signal for DSP processing
Isolated
Dual Ultrasound Board
Provides doppler shift analog signals to DSP board
SpO2 Carrier Board
Carries MSpO2 modules connecting to FE mthbd
Isolated
MSpO2 Module
Provides serial MSpO2 data to main board
Isolated
Isolated Power Supply
Provides isolated power to all front-end boards excluding US board
Isolated
Serial digital MpO2 data
FECG UA cables (2)
MECG cable
US1 cable
US2 cable
MSpO2 cable
FECG + MECG Front panel Connector
Isolated
UA Front Panel Connector
Isolated
US1 Connector
US2 Connector
MSpO2 FP Connector Bd
Isolated
Denotes Patient Isolated Sections
Denotes cables
Denotes Plug-in connections

Digital System Processor (DSP) Display PWA

The DSP Display PWA consists of two independent functioning modules: the DSP and the Display interface. The DSP processes analog and digital data from the front-end modules and interfaces to the main processor. The ECG and ultrasound analog information is processed and heart rates are output to the main board via a shared memory. Digital pressure information is received, processed, and also sent to the shared memory. The Display section, consisting mainly of a shared memory and timing generator, provides the interface between the LCD and the main processor. Circuitry for the main processor to adjust the brightness of the LCD is provided through a DC-to-AC inverter. RS-232 communications between the Main Board and the UI keypad PWA are routed through the DSP board.

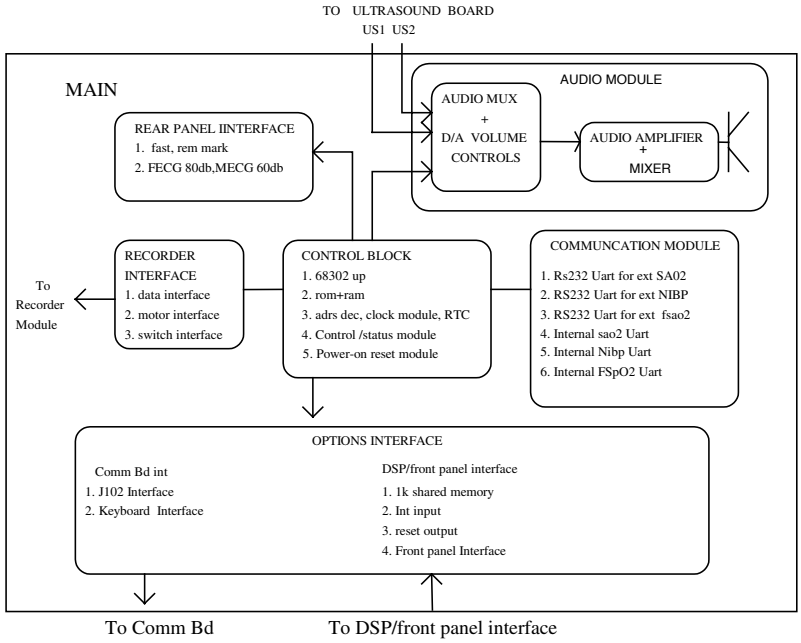

FRONT-END MOTHERBOARD 13542
US2
US1
UA
FECG
MECG
MSpo2
MSpo2 ID
FSpo2
Mspo2 Conn Bd
Fspo2 Conn Bd
Dual Ultrasound Bd 13692
FECG/UA Bd
MECG Daughter Bd (Optional)
Oximeter Carrier
MSpo2 Module Bd Universal
R/W Buffer
Fspo2 Module Bd FM401 - 330036
Comm Line Opto Isolators
Front-end 13544 Isolated Power Supply Bd
+20v
Dual US
FECG
MECG
UA
14085
RECORDER BD.
Recorder Head
Motor
Opto Sensors
Recorder head strobes and data buffers
Recorder Head Power supply
Motor Driver
Paper Out/Low Detection Circuitry
+20v, +5v
To main Bd through DSP Bd
ID Tag R/w lines
Inverter
Converter & color encoder Bd
LCD Panel Display 320 X 240
Video/Control
DSP/FRONT PANEL INTERFACE BD
Mux + A/D
UA + Isolated Mode
Control/Status Data Bus
DSP Processing System
DSP Data Bus
FPGA
Dual Port Ram To Main CPU
R/W Buffer
Video Timing Generator
Video dual Port Ram
Panel Brightness Control
Output Latch
UI Board
Micro Controller MSP430F133
Backlight LEDs
Photo Sensor
Front Panel Main Buttons
Chart Light LEDs
RS-232
Backlight LEDs
Volume Buttons
Trim Knob
Comm BD
MODE + STATUS INPUTS
to Main BD
UA, MECG, FECG
to DSP BD
Telemetry receive Mode line status port
Telemetry receive HR & UA
US AUDIO from US Bd
Main Bd Option Data Bus
Keypad receive data port
Keypad control + Status port
J102 HR, UA + mode DACs
Status Line Outputs, US Audio
MAIN BD/NBP
Serial Link to Ox
Serial Link
Recorder Interface
68302 Processing System
Real Time Clock
US Audio + Timer audio
Amp
4 Channel Audio Volume Controls + Mux
Main Bd Data Bus
Buffers
Options Interface to: 1) DSP Bd 2) Comm Bd
3 RS232 Channels
RS232 Interface (Quad UART)
Serial Link
NBP Subsystem
SYSTEM POWER SUPPLY
+5, +12, +15, -15, +20
AC INPUT
Pump, Valves & Filter

Main Board PWA

The Main Board makes up the central processing unit for the 250 Series Fetal Monitor. The Main Board accepts simultaneously processed parameters directly from four separate modules. The minimum configuration monitor has only the DSP board as an input module. Heart rate (ultrasound and or FECG), uterine activity data, mode information, and FMD data, flow from the DSP board to the Main Board via DSP board FPGA shared memory. Maternal and fetal Oximetry makes up the second and third modules. Information from these devices is passed to the Main Board via RS-232 ports. The Main Board communicates with the front panel UI keypad PWA using RS-232 interface, which is routed through the DSP board. The Main Board PWA also provides a master reset for the UI keypad PWA. The Main Board holds the NIBP control circuitry (minus pump and valves) and communicates to it using a CMOS interface. The Main Board PWA connects to the Pneumatics PWA which holds the NIBP pump, valves, and filter. The Main PWA contains three external RS232 data ports for various external devices and setup/code update functions. The Main Board PWA receives data from the rear panel options PWA to allow the added Communication features. The Main board PWA formats all the data and interfaces to the recorder PWA. The Main PWA also controls all of the audio functions including generated tones to passing ultrasound audio from the ultrasound PWA. The following sections show the block diagram of the 250 Series Main Board PWA and the data flow between the modules the Main Board.

Main Board Block Diagram

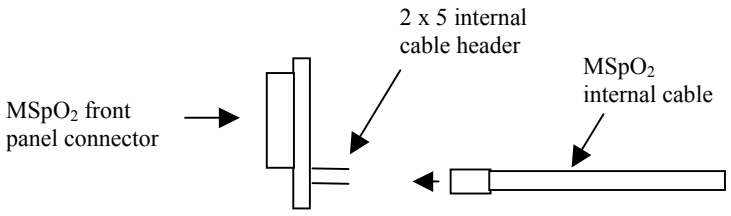
Following diagram shows the Main Board block diagram with internal and external interfaces.



MSpO$_2$ Connector PWA

The MSpO$_2$ Connector PWA receives the GEHC-IT universal SpO$_2$ patient cables on the front bezel of the 250 Series monitor and transfers the analog signals on to the

internal SpO_2 cable that in turn connects to the SpO_2 Carrier PWA. The $MSpO_2$ connector PWA keeps the sensitive analog SpO_2 signals shielded on the inner layers of the board. R1 and R2 are 0 Ohm resistors that are used to provide a means of disconnecting the shorts between pins 4 and 9 and pins 8 and 11 if needed. The shorts are present to provide Ohmeda connectivity on these no-connect pins on the universal connector. All the signals entering this PWA are patient isolated and signals leaving this PWA though the $MSpO_2$ cable are also isolated. See side view of assembly below.



SpO_2 Carrier PWA

The SpO_2 Carrier PWA holds the $MSpO_2$ module. It receives $MSpO_2$ patient cable connections from the universal front-end connector PWA and internal cable on its isolated side and routes them to the connected Nellcor MP-506 or NELL-3, Ohmeda TruSignal, or Masimo MS-11 modules. It supplies isolated power to the SpO_2 modules and transfers the isolated data generated by the modules using opto-couplers to the front-end motherboard on to the 250 Series system for processing. The 250 Series system is able to reset the maternal and the SpO_2 modules using opto-coupled reset lines.

Keypad PWA

The keypad PWA is made up of two front panel PWAs, main and volume/alarm. The main UI keypad has two functions, one for input controls and a second for the recorder chart light feature. This PWA contains most of the front panel buttons except for the volume and alarm cancel buttons and receives input from the trim knob control. The keypad is of the elastomeric type and utilizes backlight LEDs to light each key. This PWA also receives the volume/alarm keypad PWA inputs through an external cable, processes all key closures, and communicates to the main processor key status. In addition the main PWA receives data from the main processor (routed through DSP PWA) and controls the recorder-on led. The volume/ alarm PWA contains the volume and alarm key buttons and outputs to the main keypad PWA button status. It also is of the elastomeric type and has backlight LEDs for each key. The main PWA interface with the main board is through an RS-232 interface.

FECG/UA PWA

The FECG/UA PWA is made up of two separate isolated patient front-ends, FECG and Uterine pressure. The FECG front-end converts the low level signals received from the fetus through the spiral electrode to electrical impulses which are amplified, filtered, and sent across an isolation barrier. The un-isolated FECG signal then is further amplified and sent off the FECG PWA, routed by the front-end motherboard to the DSP PWA, where it is digitized and processed. In addition to this the FECG mode line (Cable plugged in sense line) from the ECG connector is

digitized and sent over the barrier via an opto coupler where it is routed similarly to the FECG analog signal.

The uterine pressure front-end processes the pressure signals from the external TOCO or IUP sensor (uses same inputs) by amplifying and filtering the inputs and converts the signals via serial analog to digital converter. The output of the A/D converter is then sent across the isolation barrier, routed through the front-end motherboard through to the DSP PWA where it is further processed. Two mode lines from the UA patient connector are also digitized, TOCO present and IUP present (only one cable can be plugged in at a time). These signals are then sent over the barrier via an opto- couplers where they are routed similarly to the TOCO/IUP digitized signals.

MECG PWA

The MECG PWA processes the isolated MECG signals present from the ECG front panel connector. The multi-lead signals first go through programmable lead switching circuitry controlled by the DSP processor. The MECG signal is then amplified and filtered and sent across the isolation barrier where it is routed through the front-end motherboard to the DSP PWA, digitized and processed. The MECG PWA also contains an ECG test signal on the isolated side which is used when the monitor front panel test button is depressed. This tests most of the front-end circuitry paths. The MECG PWA also contains pacemaker detection circuitry allowing the monitor to blank out the pulses for proper counting.

Ultrasound PWA

The dual ultrasound PWA generates the ultrasound timing signals to pulse the external patient connected ultrasound transducer crystals and provides the necessary receive circuitry to detect the reflected waveforms. It does this by first demodulating the needed signal off of the carrier and filtering the signals which are then sent through the front-end motherboard to the DSP where they are digitized and processed. No isolation is present from the patient connector through the ultrasound board as the plastic ultrasound transducer forms the physical isolation barrier.

Isolated Power Supply PWA

The isolated power supply provides all of the isolated power for the FECG/UA PWA, MECG PWA and the carrier PWA which in turn feeds the two SpO_2 modules ($MSpO_2$). The ultrasound PWA is not powered from this board as it is not electrically isolated. The isolated power supply is made up of two isolated sets of supplies. One supply set is specifically for FECG on the FECG/UA PWA. The other isolated set of supplies powers the remaining functions including TOCO/IUP (on the FECG/UA PWA), MECG (MECG board), and the SpO_2 Carrier PWA (SpO_2 modules). The unisolated power input to this PWA consists of +20 volts routed from the front-end motherboard through the DSP and Main PWAs and then finally the system power supply.

Front-End Motherboard PWA

The front-end motherboard PWA is a passive inter-connection board which houses all of the front-end parameters except for NIBP. In addition to the parameters, it holds the isolated power supply. The PWA routes all of the isolated and un-isolated signals to and from the DSP PWA. This includes both analog and digital parameter inputs and digital control outputs. On the front-end side it interfaces to the pressure channel front-end cable and the FECG front-end cable, which carries all of the

FECG signals as well as the MECG mode lines. The MECG analog signals are routed separately from the front panel to the MECG daughter PWA. The $MSpO_2$ input signals enter the SpO_2 carrier PWA directly.

Video Decoder PWA

The decoder PWA interfaces between the DSP/display PWA and the LCD panel. The video decoder performs the translation of 18 bit color required by the LCD panel to 1 bit color. This gives the LCD panel two distinct colors (foreground/background) controlled by one digital signal from the DSP PWA video generator. The translation is done by setting the unique bit patterns on the 18 video control lines. This PWA has video transmission line receivers to receive the high speed video from the DSP PWA.

Recorder PWA

The recorder PWA is responsible for driving the recorder motor and the recorder printhead device along with providing the main system PWA with paper out/low/misload status. To drive the motor it receives pulses from the main system PWA and provides the proper drive circuitry to drive the stepper motor 4 phase windings. To drive the printhead an adjustable power supply is provided which is set to the printhead specifications (each printhead is unique). Data to be printed and control information is received from the main system PWA, buffered and presented to the printhead. Sensors from the recorder assembly to detect paper low/out/misload are received and translated to digital status lines to be sent to the main system PWA.

Communications PWA

The Communications PWA contains three basic interfaces. It supports the analog interface (J102) to the legacy Spectra 400 surveillance system as well as other manufacturers centrals, a 2116 external keyboard interface for strip chart annotation, and an analog telemetry interface to the 340 telemetry system. The communications PWA communicates to the system by directly plugging into the main system PWA. Digital data from the keypad interface and telemetry (modes only) is transferred through a data bus and analog signals (MECG, FECG, Ultrasound, TOCO) from the telemetry are separately routed through the main PWA to the DSP for processing similarly to the existing front panel patient data.

3 Installation

For your notes

Tools Required

Refer to "Preventative Maintenance Inspection Report" on page 4-58 for a list of required tools.

Connections

Fetal Acoustic Stimulator ♪

This connector is provided for connection to a Corometrics Model 146 Fetal Acoustic Stimulator.

Remote Marks Connector

This connector is provided for connection to an optional Corometrics Remote Event Marker. A Corometrics Remote Event Marker is used to annotate the strip chart recorder paper with a mark.

The printed mark can be configured as ↑, commonly used to record an "event"; or it can be configured as FM↑, commonly used as an indication that the mother has perceived fetal movement. The monitor is factory set with the mark configured as an arrow. Refer to "Install Options Screens" on page 3-14 for more information on selecting the mark. Refer to the instructions accompanying the Remote Event Marker for more information about using the accessory.

ECG Out Connector

This 3-conductor stereo phone jack permits recording of FECG or MECG trends on an external recorder. ECG signals are output at +80 dB with a bandwidth of 1.0 to 100 Hz. MECG signals are output at +60 dB with a bandwidth of 0.5 to 40 Hz. The output level from this port is 10 V/mV for FECG and 1 V/mV for MECG.

CAUTION
JACK SIZES—Service personnel who are familiar with other Corometrics monitors should be aware that the stereo phone jack used on the 250 Series Monitor is a different size than that used on previous monitors.

J101 Connector (Model 340 Telemetry System Interface)

NOTE: For additional information, refer to the Model 340 Service Manual, P/N 2006920-001.

This connector is for future interfacing to the receiver of a Corometrics Model 340 Telemetry System.

A telemetry indicator is displayed beneath the FHR1 mode field:

- you connect a telemetry receiver to the 250 Series Monitor; and
- the receiver detects an active *FECG, MECG, US, TOCO,* or *IUP* mode from the associated transmitter.

NOTE: The monitor, receiver, and transmitter must all be turned on.

NOTE: When any telemetry mode is detected (*US, FECG, MECG, TOCO,* or *IUP*), all equivalent front panel modes (*US, US2, FECG, MECG, TOCO,* or *IUP*) are ignored. You ***cannot*** "mix and match" telemetry and monitor modes.

The telemetry *connected* annotation is printed on the bottom line of the top grid of the strip chart paper:

- upon commencement of telemetry monitoring; and
- every 30 minutes along with the modes.

The telemetry *disconnected* annotation is printed on the strip chart paper if:

- you unplug the telemetry receiver from the 250 Series Monitor;
- you turn off the receiver;
- you turn off the transmitter; or
- the receiver does not detect any active mode information from the transmitter.

J102 Connector (Spectra 400 Analog Interface)

This Centronics-type connector is designed for interfacing to a Corometrics Spectra 400 Central Surveillance and Alert System or other compatible analog central information system. This connector is often referred to as the Analog Interface Connector. For detailed information about connecting to a Spectra 400 System, refer to the "Systems Pre-Installation Manual" (P/N 1279AA).

J103 Connector (Model 2116B Data Entry Interface)

This connector is specifically designed for connecting to an optional Corometrics Model 2116B Data-Entry/Clinical-Notes Keyboard. For detailed information about connecting the Model 2116B to the monitor, refer to the "Model 2116B Product Manual" (P/N 1252BA).

J104 Connector

This connector attaches to a standard Nurse Call System. The connector's maximum output is 50 Vdc at 100 mA; the maximum on resistance is 0.5 Ω. When connected to a Nurse Call System, the monitor will activate the system each time a Spectra Alert is issued. This interface simulates pressing the button on a bedside Nurse Call System allowing nurses to respond to patient needs quickly and efficiently.

Although the J104 Nurse Call connector is physically present on the optional communications package, this connector is only supported as part of the Spectra Alerts option.

J109, J110, and J111 Connectors (RS-232C)

Three RS-232C serial interface connectors allow connecting the 250 Series Monitor to the following devices:

- Nellcor Puritan Bennett (NPB) N-200 Maternal Oxygen Saturation Monitor (J109 and J111 only)
- DINAMAP® PRO Series 100-400 Monitors
- DINAMAP® ProCare Monitors
- Quantitative Sentinel/Perinatal System (any RS-232C connector)

When shipped from the GE factory, all three ports are configured as follows:

- *Communications Setup* = *Nellcor*
- *baudrate* (bps) = *2400*

At the above settings, connectors **J109** and **J111** are ready for connection to an NPB Model N-200. Connector **J110** does not support a connection to NPB monitors; therefore, this connector will have to be configured for the device to which it is attached.

1. Select the *Service* softkey from the *General Setup* screen.
2. The *Service Lock* screen appears.
3. Enter the correct access code; *Install Options Screen 1* displays.
4. Select the *COMM* softkey on the bottom of *Install Options Screen 1*.
5. The *Communications Setup* screen appears.
6. Set the baudrate and mode for each port.

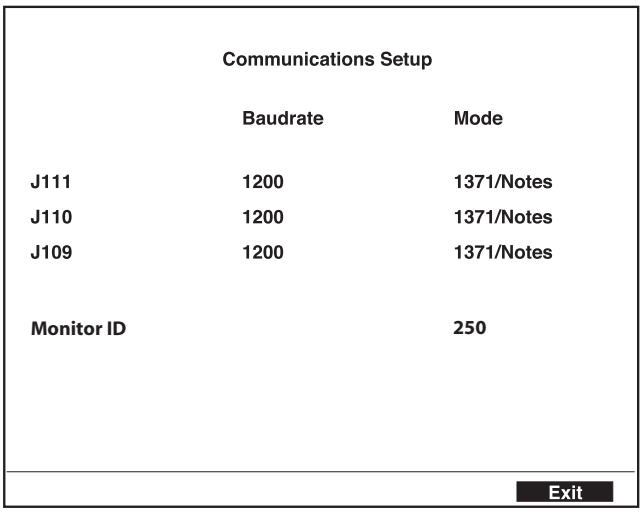
Baudrate

This field selects the baudrate and must be compatible with the external device. Use the Trim Knob control to cycle through the available settings: *600, 1200, 2400, 4800, 9600,* and *19,200 bps*. (Each port is factory set to *2400 bps.*)

Mode

This field selects the mode for communication and must be compatible with the external device. Use the Trim Knob control to cycle through the available settings: *Nellcor, Factory, Critikon, 1371,* and *1371/Notes.* (Each port is factory set to the *Nellcor* mode.)

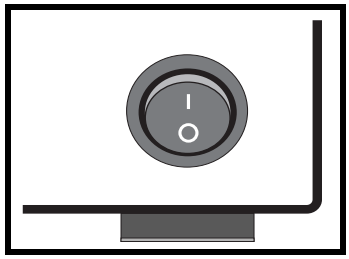
NOTE: The *Factory* mode is reserved for factory testing only.



Communications Setup Screen

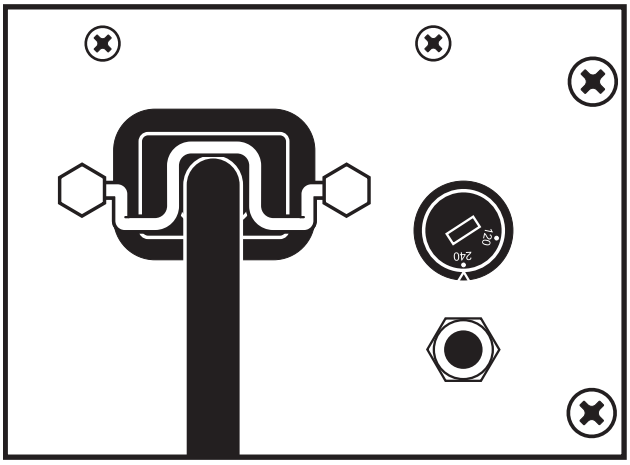
Power

1. Ensure the Power switch is in the *off* (**O**) position.



Turning the Monitor On/Off

2. Connect the detachable line cord to the rear panel power connector; plug the other end into a hospital grade grounded wall outlet of appropriate voltage. (If you are unsure about the voltage, contact your hospital Biomedical Engineering Department or GE Service Representative.)



Attaching the Power Cord

3. Turn the monitor's power on. The green indicator light, located near the upper left-hand corner of the **Light** button, illuminates and a series of tones are heard, indicating that the monitor has been turned *on*.

Self-Test Routine

The 250 Series Monitor contains a self-test routine which checks the calibration and internal circuitry of the monitor. Initiate the self-test routine at the beginning of each monitoring session to print the results on the patient's strip chart.

NOTE: To stop a self-test routine that is in progress, press the **Test** button or open the recorder door.

1. Press the **Test** button.
2. Refer to Table 7 and ensure the test results are produced as expected. At the successful completion of the self-test routine, the monitor is ready for use.

Table 7. Monitor Self-Test Routines

Test Routine	Description
Display Test	All display pixels extinguish for 1 second and then all illuminate for 1 second. Afterwards, a horizontal line moves across the screen from top to bottom, followed by a vertical line moving from left to right.
Lamp Test	The yellow **Record** indicator illuminates.
Recorder Test	The message *TEST: ARE ALL DOTS PRINTED?* prints followed by two vertical lines which should appear continuous. Discontinuous lines may be an indication of damaged printhead elements if gaps occur in the same place on both lines.
Counting Test	After the recorder test, the display returns to the main screen. The software generates a 120 bpm rate in the *FHR1* area, a 180 bpm rate in the *FHR2* area, and both mode titles display *Test.*
Uterine Activity	The monitor adds 50 mmHg to the previously displayed value in the *UA* display area; the mode title displays *Test.*

Battery-Backed RAM Status

Whenever you turn off a 250 Series Monitor, a battery provides power to the RAM (random access memory) that stores information such as time, date, default settings, etc.

Low Battery Icon

The icon shown above will appear in the upper right-hand section of the monitor under the following circumstances.

Table 8. Battery-Backed RAM Status

Icon Appearance	Reason	Solution
Icon appears and then disappears after power cycle.	Data corruption. Your monitor has reverted to factory settings.	Access setup screens and configure last-used settings.
Icon appears after multiple power cycles.	Battery requires service.	Call GE Service to report.

NOTE: It is very important to set the time and date prior to initial operation of the monitor and during daylight-saving time changes. A long-lasting battery maintains the settings even when the monitor is unplugged from AC power. Information on setting the time and date is found in the *General Setup* screen section in Chapter 4 of the *Corometrics 250 Series Monitor Operator's Manual.*

Setup

Loading Strip Chart Recorder Paper

CAUTIONS

LOADING PAPER—The instructions for loading paper into the 250 Series Monitor *are different* than the instructions for loading paper into other Corometrics monitors. Improper loading can cause paper jams. Follow the instructions carefully.

PAPER TYPE—Do not use *non*-Corometrics paper or paper designed for use with *other* Corometrics monitors. Using the wrong paper may produce inferior print quality; could result in permanent damage to the recorder's print head; and may void your warranty. Refer to Chapter 6, "Parts List, Drawings, and Replacement" for parts information.

STORAGE/TRANSPORT—Paper should be installed in the monitor's strip chart recorder at *all* times. This reduces particle build-up on the printhead and facilitates opening the recorder door.

- the recorder will not print;
- the Record indicator flashes on and off every second;
- three short chimes sound every 3 seconds at a fixed volume of 6; and the message *PAPER INCORRECTLY LOADED, RELOAD WITH BLACK SQUARES DOWN* is displayed overlaying any waveform in the maternal waveform area.

You may temporarily silence a paper-load–error condition by pressing the **Alarm Silence** button. The audio alarm will be re-issued if the paper-load–error condition continues after the specified silence period (re-alarm time). The re-alarm time is adjustable from the password-protected *Install Options Screen 2*. For further information, refer to Chapter 11, "Alarms" in the Corometrics 250 Series Operator's Manual.

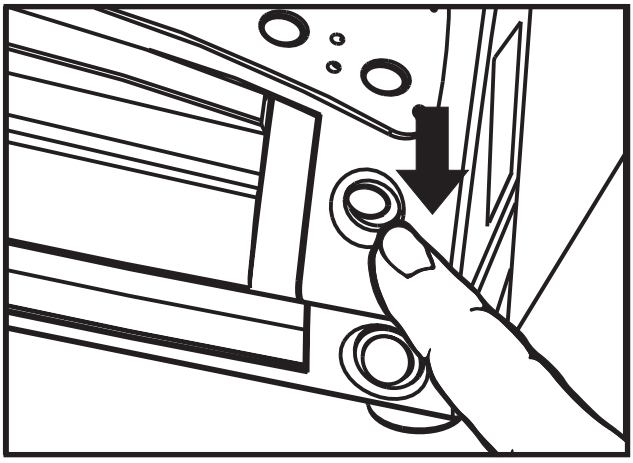
The monitor also alerts you when paper is running low and when the recorder is completely out of paper.

To install Corometrics strip chart paper in the 250 Series Monitor, follow these steps:

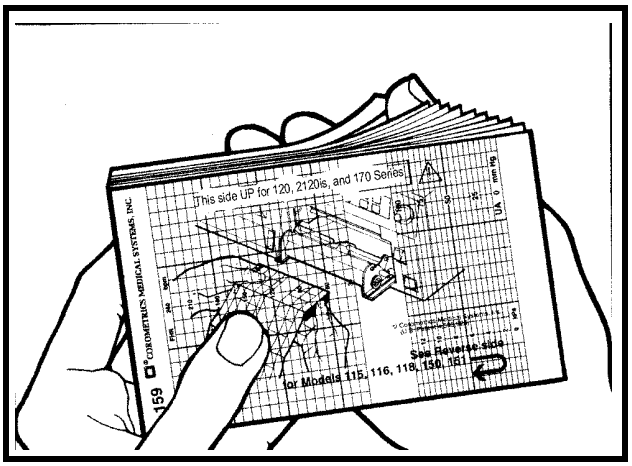
CAUTION

LOADING PAPER—Paper loading instructions for the 250 Series Monitor *are different* than other Corometrics Monitors. Improper loading can cause paper jams. Follow the instructions carefully.

1. Press down on the latch on the right side of the strip chart recorder door.



2. Fan the pack of Z-fold paper on all sides to loosen any folds and to ensure proper feed of the paper through the recorder.

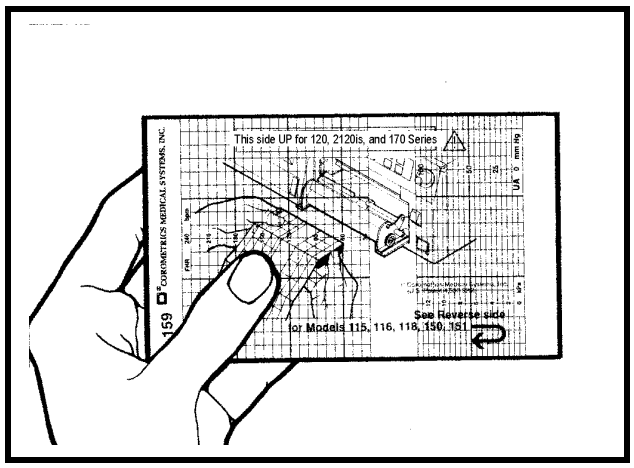

This side UP for 120, 2120is, and 170 Series
COROMETRICS MEDICAL SYSTEMS, INC.
159
See Reverse side
for Models 115, 116, 118, 150, 151

3. Hold the package of paper so that:
   - **the black squares are on the *bottom* of the pack**; and
   - the Corometrics logo and page numbers are on the *left* side of the pack.

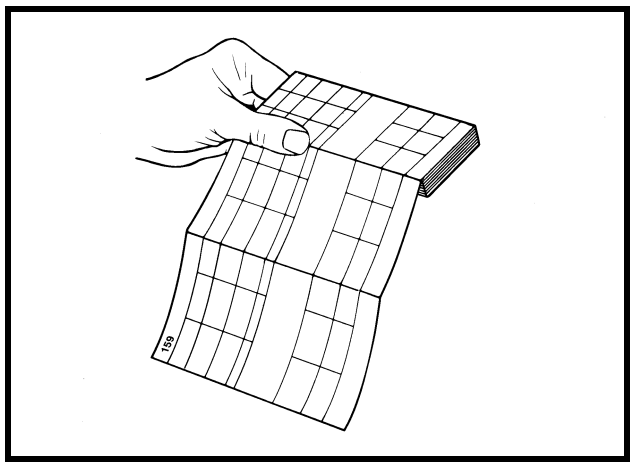
NOTE: The black squares indicate the end of the recorder paper. When the black squares appear, the strip chart recorder has approximately 20 minutes of paper remaining, when running at a speed of 3 cm/min.

NOTE: The paper is marked, “This side up for the 120, 2120is, and 170 Series.” This

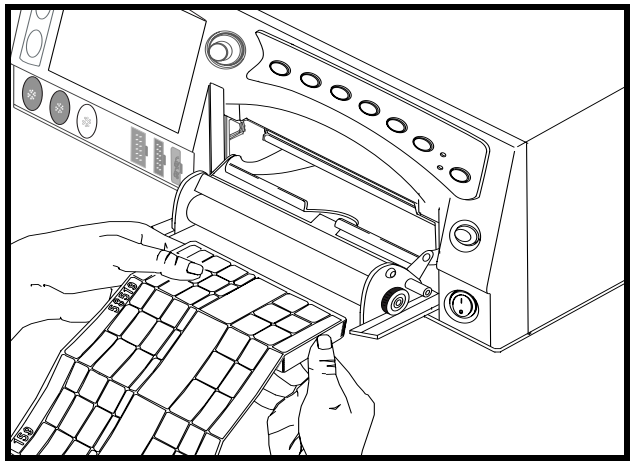
paper is compatible with and required for the 250 Series.



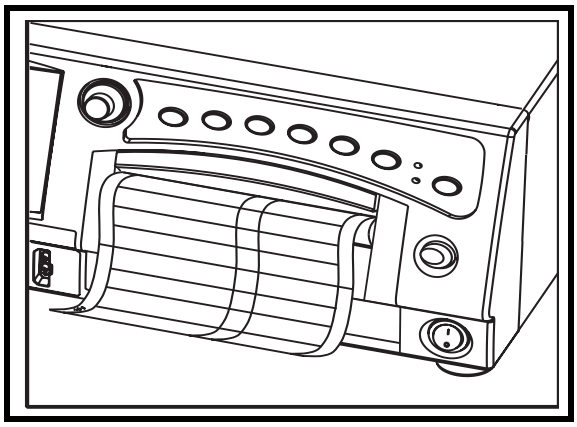
4. Unfold two sheets from the *top* of the package so that they extend toward you.



5. Place the pack in the drawer so that the pack is laying flat in the recorder.



6. Slowly close the strip chart recorder door, being careful not to skew the paper.



Mounting a Strain Gauge

To mount a strain gauge post, refer to the manufacturer's directions.

Setup Screens

The 250 Series Monitor provides a variety of options that are all selected using setup screens shown on the display. All functions are performed easily using the front panel Trim Knob. The following setup screens are selectable from the display:

- *FECG*
- *US*
- *US2*
- *Maternal NIBP*
- *MSpO$_2$*
- *MHR/P*
- *Master Alarm*
- *General Setup*

For information on individual setup screens, refer to Chapter 5 of the Corometrics 250 Series Monitor Operator's Manual. For information on default settings, refer to the Table , "Factory Defaults," on page 3-23.

Service Mode Screens

The 250 Series Monitor is programmed with five service mode screens. These screens are listed below:

- *Service Lock*
- *Install Options Screen 1* and *2*
- *Error Log* (Refer to "Self-Test Routine" on page 4-20.)
- *Communications Setup* (Also, refer to "Peripheral Components" on page 2-14.)
- *Diagnostic Control* (Refer to "Self-Test Routine" on page 4-20.)
- *NIBP Calibration*

Service Lock Screen

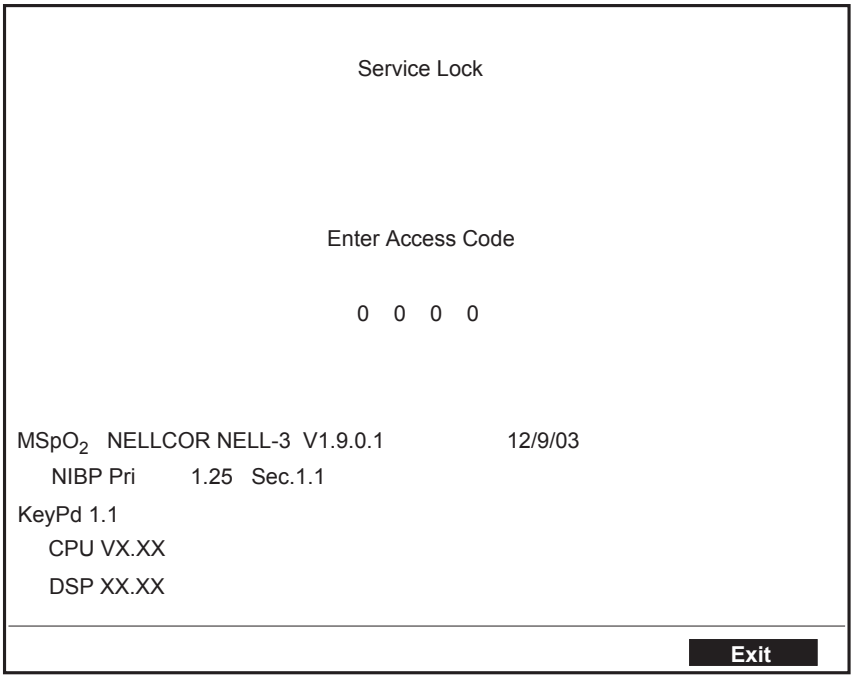
The "Service Lock Screen" on page 3-13, is used to access the remaining service screens. It displays the following information:

- Keypad Version
- $MSpO_2$:
  - For Nellcor: Nellcor 506 or NELL-3 Version and Date
  - For Masimo: DSP: Version, MCU: Version, PID: Version
  - For Ohmeda Oximetry: Version
- NIBP Version
- *CPU* Version
- *DSP* Version

A password is required to prevent unauthorized users from accessing the service mode screens.

To display the *Service Lock* and *Install Options Screen 1* and *2*:

1. Select the *Setup* softkey to display the *General* screen.
2. Select the *Service* softkey from the *General Setup* screen.
3. The *Service Lock* screen appears and the access code is displayed as *0 0 0 0*.



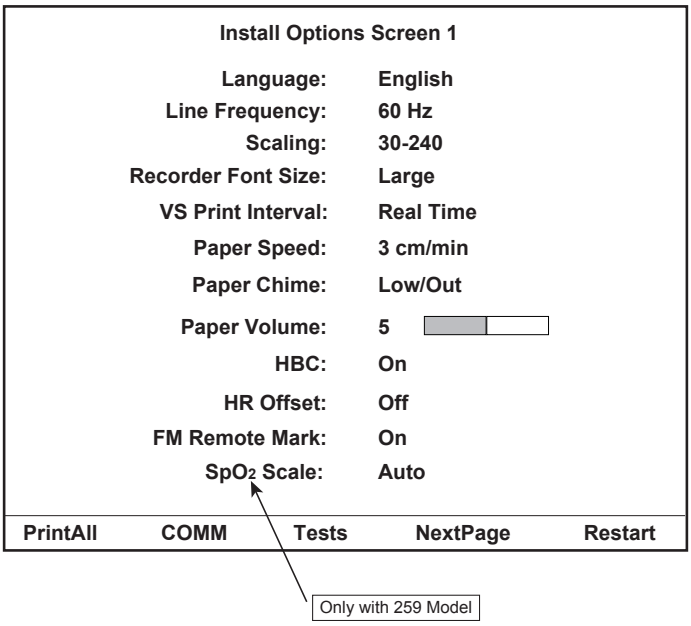
Service Lock Screen

4. The access code is the current month and day (MMDD) or day and month (DDMM), however your monitor is configured. Use the Trim Knob to enter the access code. For example: April 23 is *0 4 2 3*. 28 March is *2 80 3*.

   NOTE: The correct date and time must be set on the *General Setup* screen or you will not gain access to the service screens.

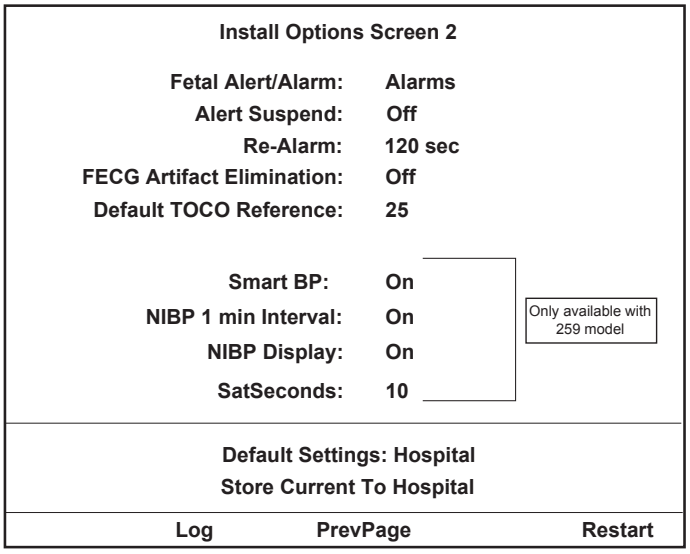
5. As soon as you enter the correct access code and press the Trim Knob, the *Install Options Screen 1* displays.

Install Options Screens



Install Options Screen 1

NOTE: The Install Options Screens consist of two separate screens. Select the *NextPage* softkey to access the second screen.



Install Options Screen 2

Language

This field is used to set the language shown on the display and printed on the strip chart recorder paper. Use the Trim Knob control to cycle through the available options: *English, Spanish, French, German, Dutch, Swedish,* and *Italian*. (The monitor is factory set for the country in which it is being used.)

Line Frequency

This field is used to define the line power frequency for the country in which the monitor is being used. Use the Trim Knob control to alternate between *50 Hz* and *60 Hz*. (The monitor is factory set for the country in which it is being used.)

Scaling

This field is used to set the heart rate scale for the strip chart paper. Use the Trim Knob control to alternate between *30–240 bpm/cm* and *50–210 bpm/cm.* (The monitor is factory set for the country in which it is being used.) The $MSpO_2$ trend *Auto* scale is also affected by this setting. When the heart rate scale is 30–240, the $MSpO_2$ expanded scale is 60–100% (10%/cm). When the heart rate scale is 50–210, the $MSpO_2$ expanded scale is 50–100% (12.5%/cm).

Recorder Font Size

The monitor offers a choice of font sizes to print annotations.

- *Small:* increases print speed.
- *Medium:* a compromise between the large and small sizes.
- *Large:* fosters readability.

VS Print Interval

The monitor provides an option for the printing of blood pressure and $MSpO_2$ values on the strip chart paper:

- *Real-Time:* Values are printed according to the actual clock time (9:33, 9:48, 10:03, etc.).
- *Chart-Style***:** Values are printed on standard clock quarter (9:00. 9:15, 9:30:, 9:45, etc), half (9:00, 9:30, 10:00, 10:30, etc), and whole hour marks (9:00, 10:00, 11:00, 12:00, etc).

Paper Chime

This field enables/disables an audible tone to indicate a low-paper or out-of-paper condition.

- *Off***:** no audio tone sounds with either condition; however, the visual indicator is still present (the recorder LED blinks).
- *Low/Out:* sounds a tone when either *LOW BATTERY* or *OUT OF PAPER* condition exists.
- *Out Only:* sounds a tone only when the *OUT OF PAPER* condition exists.

Paper Volume

This field sets the volume of the paper chime. As you adjust the volume, a sample tone sounds. You can choose from a range of *1* to *9* (*1* = lowest, *9* = loudest).

HBC (Heartbeat Coincidence)

The heartbeat coincidence feature alerts you when there is the possibility that you may be monitoring a duplicate signal. Heartbeat coincidence is indicated when any two heartbeats have a consistent phase relationship for equal to or greater than 60% of the detected beats for about 60 seconds; the cessation of coincidence is indicated when the phase relationship is inconsistent for greater than 40% of the detected beats for about 7 seconds.

When heartbeat coincidence detection is *enabled*, the acronym *HBC* appears to the right of the FHR2 mode title.

HR Offset

This field is used to enable/disable the secondary offset feature. Use the Trim Knob control to cycle through the available options: *10 min, On,* and *Off*. (The factory default setting is *10 min*.)

What is it?

When monitoring dual heart rates using US/US2 or FECG/US, overlapping traces may be difficult to interpret. All 250 Series Monitors provide a +20 bpm shift for the secondary fetal heart rate trend to alleviate this problem. When using US/US2 or FECG/US2, and the US2 trace is shifted +20 bpm, the US2+20 symbol prints on the upper portion of the top grid every 4.5 cm. When using US/FECG, and the US trace is shifted +20 bpm, the US + 20 symbol prints on the upper portion of the top grid every 4.5 cm. In both cases, an arrow (→) and a vertical dashed line are printed to draw attention to the start of the shifted trend.

10 min
The heart rate offset mode is enabled with an auto-revert feature. If the trace is shifted by the user, the heart rate will revert back to the normal (unshifted) level after 10 minutes.

On
The heart rate offset mode is enabled. If the user shifts a trace, the trace will remain shifted until the user manually sets the trace back to normal (unshifted level).

Off
The heart rate offset mode is disabled. The user cannot shift traces.

NOTE: Refer to the operator's manual for information about activating the heart rate offset mode.

FM Remote Mark

This field configures the marker annotation that is printed on the strip chart paper whenever a patient presses the button on the Remote Marker accessory. Use the Trim Knob control to alternate between *On* and *Off*. The factory default setting is *Off*.

The annotation is commonly used to record an "event"; while the

annotation is commonly used as an indication that the mother has perceived fetal movement.

SpO_2 Scale

Two scale options are available for printing the $MSpO_2$ trends. The scale is printed on the paper along with the trend.

- *Auto:* The trend plots on an expanded scale of 60–100% or 50–100%, depending on the paper.[1]
- *0–100%:* This option configures the $MSpO_2$ trend to always plot at a fixed scale of 0–100%.

Fetal Alert/Alarms

If the Spectra Alerts option is installed in your monitor, use this field to select between the built-in FHR alarm features of the monitor and the Spectra Alerts option.

- *Alarms:* The monitor generates alarms based on the limit settings provided on the FHR setup screens.
- *Alerts:* Enables the Spectra Alerts feature to analyze heart rate and uterine activity data to detect certain abnormal trends and alert the clinician.

Alert Suspend

When a care provider is at the patient's bedside, it may be desirable to suspend the audio component of alerts.

- *Off* (disabled)**:** users are unable to suspend audio alerts.
- *On* (enabled)**:** users can manually activate/de-activate the function.

Re-Alarm

This field adjusts the temporary silence period. An audio alarm is cancelled using the **Alarm Silence** button. However, for MECG and $MSpO_2$ monitoring and during a paper-load error condition, an alarm will be re-issued if the alarm state continues after a specified amount of time.

FECG Artifact Elimination

This field is used to enable/disable *FECG Artifact Elimination* which affects only the direct FECG mode. Use the Trim Knob to alternate between *On* and *Off*. (The factory default setting is *Off*.) When *On* is selected, any new heart rate value which differs by more than ±25 bpm from the previously calculated heart rate is not printed on the strip chart paper. When *Off* is selected, all heart rate values are printed on the strip chart paper without regard to previous rates.

Theory and Methodology

When FECG artifact elimination is turned *on*, the monitor does not print any new FHR value which differs by more than ±25 BPM from the previously calculated heart rate value. The printing inhibition functions on a beat-to-beat basis by comparing the last calculated rate against the newly calculated rate. The rate used for comparison purposes is always the previous rate regardless of whether this rate passed the previous ±25 BPM test. When FECG artifact elimination is turned *off*, the direct FECG rate is plotted by the recorder without regard to its deviation from the previous rate. The effect of this function change is that sudden heart rate changes (such as certain arrhythmias, accelerations or decelerations) as well as artifactual changes (as when the electrode is disturbed or loosely connected) are recorded when FECG artifact elimination is turned *off*. They are not recorded when FECG artifact elimination is turned *on*; instead gaps (pen lift) in the tracing occur.

Default TOCO Reference

This field sets the *default* uterine activity pressure reference for the tocotransducer. Use the Trim Knob control to cycle through the available settings: *5, 10, 15, 20,* or 25 relative units in mmHg mode or *0.7, 1.3, 2.0, 2.7,* or 3.3 in kPa mode. (The factory default setting is 10 in mmHg mode or 1.3 in kPa mode.)

When using a tocotransducer, *momentary* depression of the **UA Reference** button sets the pressure baseline at the *default* setting.

Pressing the **UA Reference** button for more than 2 seconds causes the UA reference value to override the default setting and cycle through all available selections: *5, 10, 15, 20,* or 25 relative units in mmHg mode or *0.7, 1.3, 2.0, 2.7,* or 3.3 in kPa mode, starting at the *default* setting until the button is released. This value is stored as the new baseline for the currently measured uterine activity signal; as soon as the **UA Reference** button is momentarily pressed, the baseline returns to the *default* value.

Smart BP

The 250 Series has a *Smart BP* feature that prevents an automatic blood pressure determination from occurring during a uterine contraction.
This feature:

- reduces the chances for erroneous vital signs readings; and
- reduces patient discomfort during labor.

[1] The $MSp0_2$ trend is plotted over a range of 60-100% on paper with a HR scale of 30-240 bpm. The $MSp0_2$ trend is plotted over a range of 50-100% on paper with a HR scale of 50-210 bpm.

NIBP 1 min Interval

This field is used to enable/disable the 1 minute interval selection on the maternal BP Setup screen. Use the Trim Knob control to alternate between *On* and *Off*. (The factory default setting is *Off*.)

NIBP Display

Setting this field to a value reduces the chance of error. Setting this field to *On* leaves the blood pressure reading displayed indefinitely and could potentially cause confusion. For example: if the monitor is configured for manual mode and 1 hour has elapsed since the last reading, the continuous display of the "old" NIBP reading may cause confusion.

This field determines the time period, in minutes, that a blood pressure reading remains displayed before being automatically erased,[1] starting from the time the reading is displayed.

Pressure Units

The *Pressure Units* allows you choose either mmHg or kPa.

SatSeconds

The *SatSeconds* limit controls the time that the SpO_2 level may fall outside the alarm before an audible alarm sounds. The *SatSeconds* default setting is set at 10 *SatSeconds*. Your biomed may set the *SatSeconds* limit (*Off*, *10, 25, 50,* or *100*) to suit the clinical environment and patient condition.

Default Settings

The 250 Series Monitor is shipped with factory defaults for the setup screens. You can change most of these settings to suit your particular needs. The monitor has two *Default Settings:* that allow you to determine the settings on the next power-on or restart: *Factory* or *Hospital*.

- *Factory:* Select this option if you wish to return all monitor settings back to the factory default settings (refer to the table at the end of this section). Factory defaults represent settings chosen to meet the requirements of a typical labor and delivery environment.

  NOTE: You may adjust the setup screen configurations as needed during monitoring; however, be advised that if you turn off the monitor, all user setup screens revert to the factory defaults when the monitor is turned on again.

- *Hospital:* The *Hospital* option allows your hospital to configure its own set of preferences to be used each time the monitor is powered on. Record your hospital settings in the table at the end of this section. You may adjust the setup screen configurations as needed during monitoring; however, be advised that if you turn off the monitor, all user setup screens revert to the factory defaults when the monitor is turned on again.

Store Current To Hospital

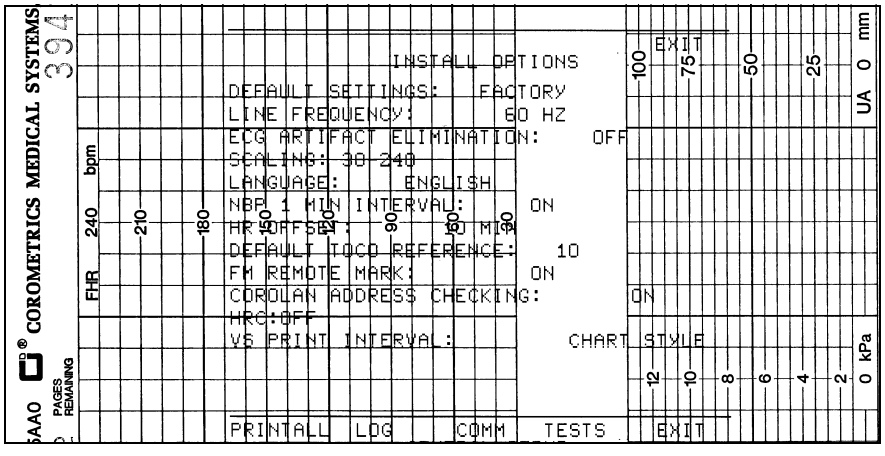
Select this option if you wish to store your current monitor settings as your hospital's preferred default settings. When you select this option, the *Default Settings:* softkey reflects the change (i.e., *Default Settings:* change to *Hospital*).

Printing System Setup Information

Use the Trim Knob to select the *PrintAll* softkey on the bottom of *Install Options Screen 1* to see an overall summary of the monitor's setup screens. A screen capture of each system setup screen (user and service) is printed on the strip chart paper. The following screen summaries are printed:

- *Diagnostic Control*
- *Communications Setup*
- *Install Options*
- *General Setup*
- *Master Alarm Setup*
- *Vital Signs History*
- *MSpO$_2$ Setup*
- *MHR/P Setup*
- *NIBP Setup*
- *FECG Setup*
- *US Setup*
- *US2 Setup*

NOTE: The *FECG, US,* and *US2 Setup* screens are shown together in one group. In addition, the *HR Offset* field is separated on this summary screen, since it may appear on either the *US* or the *US2 Setup* screen—depending on the active connectors. See sample printout below.



Install Options Portion of System Setup Printout

[1] Values are removed from the NIBP area of the display only; values are still retained in memory for display and printing in the Maternal Vital Signs History screen.

Communications Setup Screen

The Communications Setup screen, allows you to configure the unit's **J109, J110,** and **J111 RS-232C** Serial Interface ports for connecting to optional peripheral equipment. Each port is configured for baudrate and mode.

To use the *Communications Setup* screen:

- Select the *Service* softkey from the *General Setup* screen.
- The *Service Lock* screen displays.
- Enter the correct access code; *Install Options Screen 1* displays.
- Select the *COMM* softkey on *Install Options Screen 1*.
- The *Communications Setup* screen appears.

Baudrate

This field selects the baudrate for communication with an external device. Use the Trim Knob control to cycle through the available settings: *600, 1200, 2400, 4800, 9600,* and *19,200 bps.* (Each port is factory set to *2400 bps.*) Refer to "Peripheral Components" on page 2-14 for more information about configuring this field.

Mode

This field selects the mode for communication with an external device. Use the Trim Knob control to cycle through the available settings: *Nellcor, Factory, Critikon, 1371, 1371/NOTES, LOOPBACK, 115,* and *115 X/R.* (Each port is factory set to the *Nellcor* mode.) Refer to "Peripheral Components" on page 2-14, for more information about configuring this field.

NOTE: At the factory default settings of *2400 bps* and the *Nellcor* mode, connectors **J109** and **J111** are ready for connection to a Nellcor Puritan Bennett (NPB) Model N-200 or Model N-400. Be advised that connector **J110** does not support a connection to a NPB monitor; therefore, this connector will have to be configured for use with another device, if appropriate.

Configuration Switches

The switches configure the operational characteristics of the 250.

Switch	Name	Setting
1	Factory Test	Off = Enabled
2	J102 Levels	Off = HP, On = Coro
3	RESERVED	Set to Off
4	NIBP Option	Off = Enabled
5	$MSpO_2$ Option	5:Off 6:Off = Nellcor 5:Off 6:On = Ohmeda 5:On 6:Off = Masimo 5:On 6:On = No $MSpO_2$
6		
7	RESERVED	Set to On
8	MECG Option	Off = Enabled

Factory Defaults

Table 1. Summary of Factory Defaults				
Setup Screen	**Field Description**	**Factory Default**	**Default Options**	**Hospital Preference**
FECG or US/US2	FHR Volume	5	0-9	
	FHR Alarm Limits	High Low 160 120 bpm	200-140, Off 60-140, Off	
	Audio Alarms	On	On, Off	
	Volume	5	1-9	
NIBP	Initial Target Pressure	135 mmHg (18.0 kPa)	100-250 mmHg in increments of 5; (13.3-33.3 kPa in 0.7 steps	
	Mode	Manual	Manual, 1, 2, 3, 4, 5, 10, 15, 20, 30, 40, 45, 60, 90, 120 min	
	NIBP Done Vol	5	0-9	
	Alarm (mmHg mode) Systolic Diastolic MAP MHR/P	High Low 160 90 mmHg 90 50 mmHg 140 50 mmHg 120 50 bpm	High Low 70-240 50-150 70-130 30-120 70-150 30-120 100-250 35-120	
	Alarm (kPa mode) Systolic Diastolic MAP MHR/P	High Low 21.3 12.0 kPa 12.0 6.7 kPa 18.7 6.7 kPa 120 50 bpm	High Low 9.3-32.0 6.7-20.0 9.3-17.3 4.0-16.0 9.3-20.0 4.0-16. 100-250 35-120	
	Volume	5	1-9	

Table 1. Summary of Factory Defaults				
Setup Screen	**Field Description**	**Factory Default**	**Default Options**	**Hospital Preference**
$MSpO_2$	Response Time (Nellcor 506)	Fast	Normal, Fast	
	Response Time (Nellcor NELL-3)	Fast	Fast	
	Averaging Time (Masimo)	8 seconds	2, 4, 8, 10, 12, 14, 16 seconds	
	Sensitivity (Masimo)	Normal	Normal, Maximum	
	Print Interval	5 minutes	Off, 2, 5, 10, 15, 30, 60 minutes	
	$\%O_2$ Trace	Off	On, Off	
	Alarms $MSpO_2$ MHR/P	High Low 100 95% 120 50 bpm	High Low 85-100 80-99 100-250 35-120	
	Volume	5	1-9	
MHR/P	Source	Auto	Auto, MECG, $MSp0_2$, NIBP	
	MHR/P Trace	Off	On, Off	
	Volume	0	0-9	
	Alarms	High Low 120 50 bpm	High Low 100-250 35-120	
	Alarm Volume	5	1-9	
	MECG Lead	II	I, II, III	
	Pacer	Off	On, Off	
Normal Operation	(Waveform Display)	MECG	FECG, MECG, $MSp0_2$, Off	
	(MECG Waveform Size)	1X (1 mV/cm)	0.25X, 0.5X, 1X, 2X, 4X, Auto	
Master Alarm Setup	Alarm Limits (mmHg) Systolic Diastolic MAP MHR/P $MSpO_2$	High Low 160 90mmHg 90 50 mmHg 140 50 mmHg 120 50 bpm 100 95%	High Low 70-240 50-150 70-130 30-120 70-150 30-120 100-25 35-120 85-100 80-99	
	Alarm (kPa mode) Systolic Diastolic MAP MHR/P	High Low 21.3 12.0 kPa 12.0 6.7 kPa 18.7 6.7 kPa 120 50 bpm	High Low 9.3-32.0 6.7-20.0 9.3-17.3 4.0-16.0 9.3-20.0 4.0-16. 100-250 35-120	
	Volume	5	1-9	

Table 1. Summary of Factory Defaults				
Setup Screen	**Field Description**	**Factory Default**	**Default Options**	**Hospital Preference**
General Setup	Play Song	Off	Off, Happy Birthday, Brahms' Lullaby, Rock-a-Bye-Baby, All	
	Song Volume	5	0-9	
	Brightness	9	0-9 (nine = brightest)	
	Paper Speed	United States: 3 cm/min International: 1 cm/min	1-3 cm/min	
	Date	Set to current local date.	Set to current local date.	
	Time	Set to current local time. Must manually change to EST/EDT.	Set to current local time.	
	$MSpO_2$ Print Interval (External Monitor)	5 min	Off, 2, 5, 10, 15, 30, 60 min	
	$FSpO_2$ Print Interval (External Monitor)	5 min	Off, 2, 5, 10, 15, 30, 60 min	
	$FSpO_2$ Trace	Off	Off, On	
Vital Signs History	HX Interval	Event	1, 5, 10, 15, 30, 60, Event	

Table 1. Summary of Factory Defaults				
Setup Screen	**Field Description**	**Factory Default**	**Default Options**	**Hospital Preference**
Install Options Screen 1 (Service)	Language	Set according to shipping destination	Set according to shipping destination	
	Line Frequency	United States: 60 Hz International: 50 Hz	50 Hz, 60 Hz	
	Scaling	United States: 30–240 bpm International: 50–210 bpm	United States: 30–240 bpm International: 50–210 bpm	
	Recorder Font Size	Medium	Small, Medium, Large	
	FECG Artifact Elimination	Off	On, Off	
	Paper Chime	Out Only	Off, Low/out, Out only	
	Paper Chime Volume	5	1-9	
	HBC (Heartbeat Coincidence Enable)	On	On, Off	
	HR Offset (Applies to US or US2—whichever is FHR2)	10 min	Off, On, 10 min	
	FM (Fetal Movement) Remote Marker	On	On, Off	
	SpO_2 Scale	0–100%	Auto, 0-100% (Does not change)	
Install Options Screen 2 (Service)	Fetal Alert/Alarm	Off	Off, Alarms, Alerts	
	Alert Suspend	Off	Off, On	
	Re-Alarm (MECG and SpO_2 only)	120 sec	120 - 300 seconds in 5-second intervals	
	VS (Vital Signs) Print Interval	Real Time	Real Time, Chart Style	
	Default TOCO Reference	10 in mmHg mode or 1.3 in kPa modes	5, 10, 15, 20, or 25 relative units in mmHg mode or 0.7, 1.3, 2.0, 2.7, or in 3.3 kPa mode	
	Smart BP	On	On, Off	
	NIBP 1-min Interval	On	On, Off	
	NIBP Display	On	On, 1, 2, 3, 5, 10, 15, 30 min	
	Pressure Units	mmHg China: kPa	mmHg, kPa	
	SatSeconds (Nellcor)	10	Off, 10, 25, 50, 100	
	Default Settings	Factory	Factory, Hospital	

4 Maintenance

For your notes

Maintenance Schedule

Cleaning	Calibration Frequency	Maintenance Frequency	Self-Test Frequency
TOCO		as needed	
U/S Transducers		as needed	
MECG Cables		as needed	
Main Board Battery		as needed	
Monitor Exterior		as needed	
Monitor		vacuum interior	Before each monitoring session
Printhead		as needed	
Main Board power supply voltages	annually or when the monitor operation is suspect		
Isolated power supply board voltages	annually or when the monitor operation is suspect		
FECG/UA board voltages	annually or when the monitor operation is suspect		
Printhead	adjust, remove, replace as needed		
Recorder board photo sensors	adjust, remove, replace as needed		
Pneumatic pressure check	annually		
Unit to primary leakage		as needed	
Patient to line leakage for ECG		as needed	
Patient to line leakage for IUP		as needed	
Patient to line leakage for $MSpO_2$		as needed	
Patient to line leakage for US		as needed	
Patient to line leakage for US2		as needed	
Ground Continuity	annually or when the monitor operation is suspect		
FECG	Measure voltage breakdown		
MECG	Measure voltage breakdown		
IUP	Measure voltage breakdown		
$MSpO_2$	Measure voltage breakdown		
US	Measure voltage breakdown		

Cleaning	Calibration Frequency	Maintenance Frequency	Self-Test Frequency
US2	Measure voltage breakdown		
Mains to Chassis using DC voltage for 1 min.	hi-pot voltage tester 2.121 kVdc		
Display Check	Verify DSP board operation, Remove, Replace, Upgrade		
Trimline TOCO Calibration	As needed		
Nautilus TOCO Calibration	As needed		
$MSpO_2$ Calibration	automatic		
Diagnostic Control Screen			As needed
J102 Analog DAC Static Test			As needed
RS-232C Connector Loopback Test			As needed

Visual Inspection

The monitor and its components should be carefully inspected prior to installation, once every 12 months thereafter and each time the equipment is serviced.

- Carefully inspect the equipment for physical damage to the case, the display screen, and the keypad. Do not use the monitor if damage is determined. Refer damaged equipment to qualified service personnel.
- Inspect all external connections for loose connectors or frayed cables. Have any damaged connectors or cables replaced by qualified service personnel.
- Inspect the display face for marks, scratches, or other damage. Physical damage to a flat panel display glass may pose an implosion hazard. Have the flat panel display replaced by qualified service personnel if necessary.
- Safety labels and inscription on the device are clearly legible.

NOTE: If an accessory is not listed, consult the manufacturer's instructions.

Cleaning

General care and cleaning are required for the 250 Series Monitor and its accessories. If an accessory is not listed, consult the manufacturer's instructions.

CAUTION
Unplug the monitor from the AC power source and detach all accessories from the monitor. Do not immerse accessories in any liquid. Do not use abrasive cloth or cleaners on monitor or accessories.

Monitor Exterior

1. The exterior surfaces of the equipment may be cleaned with a dampened, lint-free cloth. Use one of the following approved solutions:
   - Commercial diluted bleach solution
   - Mild soap (diluted)
   - Commercial diluted ammonia solution

   NOTE: Always dilute cleaning solutions per manufacturers' recommendations.
2. Wipe off cleaning solutions with a clean dry cloth.
3. Do not use a cleaning substance containing wax.
4. Do not pour or spray water or any cleaning solution on the equipment or permit fluids to run behind switches, into the connectors, into the recorder, or into any ventilation openings in the equipment.
5. Do not use the following cleaning agents:
   - Abrasive cleaners or solvents of any kind
   - Acetone
   - Ketone
   - Alcohol-based cleaning agents or
   - Betadine

CAUTION
Failure to follow these rules may melt, distort, or dull the finish of the case, blur lettering on the labels, or cause equipment failures. Cleaning products known to cause the types of problems mentioned above include, but are not limited to Sani-Cloth Wipes*, Sani-Wipes*, and Ascepti Wipes*. These should be avoided. Products containing active ingredients and solutions similar to these products should also be avoided.

Display

To clean the display screen, use a soft, clean cloth dampened with a glass cleaner. Do not spray the glass cleaner directly onto the display. Do not use alcohol or hospital disinfectants like Cidex* or Betadine.

Tocotransducer and Ultrasound Transducer

CAUTIONS

ABRASION—Do not use abrasive cloth, sharp objects, or abrasive cleaners.

ALCOHOL—Do not use Alcohol in cleaning solutions.

DISCONNECTION—Detach the transducers from the monitor.

NOTE: Only Nautilus transducers are immersible.

1. Dampen a cloth or paper towel with one of the following products; then wring out until only slightly wet:
   - Sodium Hypochlorite 5.25% (Bleach) diluted 10:1
   - Cidex*
   - Sporicidin*
   - Soap and water
2. Rub soiled area until clean, taking care not to excessively wet the tocotransducer diaphragm seal. Rub around the seal.
3. Dry with a soft, dry cloth.

Leg Plates and MECG Cables

CAUTIONS

ABRASION—Do not use abrasive cloth, sharp objects, or abrasive cleaners.

ALCOHOL—Do not use Alcohol in cleaning solutions.

DISCONNECTION—Detach the cables/legplate from the monitor.

IMMERSION—Do not immerse cables or hold under running water.

*Trademarked

1. Dampen a cloth or paper towel with one of the following products; then wring out until only slightly wet:
   - Sodium Hypochlorite 5.25% (Bleach) diluted 10:1
   - Cidex*
   - Sporicidin* Soap and water
2. Rub soiled area until clean.
3. Dry with a soft, dry cloth.

Maternal NIBP Cuffs and Hoses

General

The cuff must be thoroughly cleaned with the specified detergent before reuse. The additional use of household bleach as described below provides at least intermediate-level disinfection.

- Apply cuff hose plugs before cleaning.
- The following cleansing procedure was repeated 20 times on DURA-CUF® Blood Pressure Cuffs and once on SOFT-CUF® Blood Pressure Cuffs without affecting the performance of the cuff.
- While this procedure is adequate for cleaning/disinfection, it may not remove all stains.
- Do ***not*** immerse hoses.
- Do ***not*** immerse cuffs without prior application of cuff hose caps.

Materials

- Enzymatic detergent such as ENZOL* enzymatic detergent (US) or Cidezyme* enzymatic detergent (UK)
- Distilled water
- 10% solution of household bleach (5.25% sodium hypochlorite) in distilled water
- Soft cloths and soft-bristled brushes
- Spray bottles

Procedure

1. Prepare the enzymatic detergent according to the manufacturer's instructions and the 10% bleach solution, in separate spray bottles.
2. Spray the detergent liberally on device. If the material is dried on, allow the cuff to sit for 1 minute. For soil on the soft part of the closure or the cuff itself, wipe the material off with a soft cloth. For persistent contamination on the soft part of the closure, use a soft-bristled brush to loosen particles. Rinse with copious amounts of distilled water. Repeat until no visible contamination remains. For soil on the hook part of the closure, use a soft-bristled brush to remove the material, and rinse with copious amounts of distilled water. Repeat until no visible contamination remains.

*Trademarked

3. Spray the 10% bleach solution on the affected area until the area is saturated. Allow the cuff to sit for 5 minutes.
4. Wipe away any excess solution and rinse the cuff again with distilled water. Allow 2 hours for drying.

The user has the responsibility to validate any deviations from the recommended method of cleaning and disinfection.

For additional information on infection control procedures, contact GE Medical Systems *Information Technologies* Technical Support.

SpO_2 Sensors

Adhesive sensors are sterile and for single use only. Reusable sensors should be cleaned before reuse with a 70% alcohol solution. If low-level disinfection is required, use a 1:10 bleach solution. Do not use undiluted bleach (5% - 5.25% sodium chlorite) or any cleaning solution other than those recommended here because permanent damage to the sensor could occur. Do not sterilize the sensor by irradiation, steam, or ethylene oxide. If disposable sensors or their packaging are damaged, they must be disposed of as advised in this appendix.

To clean or disinfect the sensor:

1. Saturate a clean, dry gauze pad with the cleaning solution. Wipe all surfaces of the sensor and cable with this gauze pad.
2. Saturate another clean, dry gauze pad with sterile or distilled water. Wipe all surfaces of the sensor and cable with this gauze pad.
3. Dry the sensor and cable by wiping all surfaces with a clean, dry gauze pad.

Periodic Thermal Printhead Cleaning

The thermal printhead heater elements must be cleaned at regular intervals to remove any accumulated paper dust. The heater elements may be cleaned with methanol or isopropyl alcohol. Care must be taken to avoid touching the heater elements with bare hands.

CAUTION
AIR DRYING – Allow to air dry completely prior to using the monitor.

Cleaning the UA Strain Gauge

1. Remove the plastic dome.
2. If desired, wash the transducer with sterile water or saline solution.
3. Carefully clean the diaphragm seal with a cotton swab to remove deposits. Avoid excessive pressure since this may damage the diaphragm. If there are excessive stains on the diaphragm or sides of the transducer, remove with a cotton swab and solvents of increasing strength.

4. After cleaning, rinse the transducer thoroughly in distilled water and replace the dome loosely.
5. Dry the transducer with sterile gauze.

CAUTIONS
AUTOCLAVE—Do not autoclave pressure transducer.

IMMERSION—Do not immerse any part of the electrical connector of the transducer in the cleaning solution at any time. Examine the outer sheath of the cable for perforations. If the outer covering is damaged in any way, do not immerse the cable in the cleaning solution; this may result in moisture entering the transducer case, which is vented through the cable.

WARNING
LIQUIDS—If liquids enter the electrical connector, check the resistance between the electrical element and the transducer case. A resistance level of greater than 10 M¾ ensures that the leakage current is within acceptable levels for safe use on patients.

6. Leave transparent dome attached to the transducer during storage, but slacken the locking ring at least one quarter of a turn.

CAUTION
STERILIZATION—Prior to patient use, ensure the dome is sterile.

Disposal of Product Waste

As you use the 250 Series monitor, you will accumulate solid wastes that require proper disposal or recycling. These include patient applied parts and packaging material.

Patient Applied Parts

Certain patient applied parts, such as those with adhesive (disposable SpO_2 sensors), are intended for single use and should be disposed of properly as medical waste in accordance with regional body controlled guideline.

Other patient applied parts, such as blood pressure cuffs, should be cleaned according to instructions. Inspect reusable applied parts for wear, replace as necessary, and dispose of used product as medical waste in accordance with regional body controlled guideline.

Packaging Material

Retain original packaging materials for future use in storing or shipping the monitor and accessories. This recommendation includes corrugated shippers and inserts.

Whenever possible recycle the packaging of accessories and patient applied parts.

Monitor

At the end of its service life, the product described in this manual, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have questions concerning disposal of the product, please contact GE Medical Systems *Information Technologies* or its representatives.

Electrical Safety Tests

Refer to the "Preventative Maintenance Inspection Report" on page 4-58 for required tools to perform all electrical safety tests in this section.

IMPORTANT

UNITS OF MEASURE—The specified leakage tester (E278-06) measures in mV. There is a direct correlation of mV to µA. In other words, on this text fixture, 1 mV = 1 µA.

220/230/240 VAC POWER CORD—For 220/230/240 VAC testing, use only P/N 600034 line cord to power the E278-06 test fixture.

Initial Conditions

1. Attach the monitor power cord to the leakage test fixture.
2. Verify that the leakage test fixture's main AC power cord is attached.

AC Line

Voltage measurement from 100–240 V.

Ground Impedance

300 mΩ, lead to rear panel equipotential ground lug

300 mΩ, lead to top cover bezel screw

Unit to Primary Leakage

1. Set the fixture's **Leakage** switch to **Unit**.
2. Turn ON the monitor using the monitor's power switch.

3. Verify the following:
   - < 300 µA (100, 120, 220, 230, or 240 VAC monitors)
4. Record the primary leakage for the following conditions:

Table 1. Unit to Primary Leakage Conditions		
Neutral	**Ground**	**Power (Polarity)**
_____ Closed	_____ Closed	_____ Normal
_____ Closed	_____ Open	_____ Normal
_____ Closed	_____ Open	_____ Reversed
_____ Closed	_____ Closed	_____ Reversed
_____ Open	_____ Closed	_____ Normal
_____ Open	_____ Closed	_____ Reversed

Patient-to-Ground Leakage for ECG

1. Connect an ECG test body to the monitor's front panel **ECG** input. The ECG test body can be shorted MECG cable, or the assembly leakage cable.

   IMPORTANT
   TEST CABLES—If you use transducers in lieu of the assembly leakage cable, and you are testing a Model 129/129F Monitor, you must test both FECG and MECG.

2. Set the fixture's **Leakage** switch to **Patient**.
3. Turn ON the monitor using the monitor's power switch.
4. Verify the following:
   - < 50 µA (100, 120, 220, 230, or 240 VAC monitors)
5. Record the patient-to-ground leakage for the following conditions:

Table 2. Patient-to-Ground Leakage Conditions for ECG		
Neutral	**Ground**	**Power (Polarity)**
_____ Closed	_____ Closed	_____ Normal
_____ Closed	_____ Open	_____ Normal
_____ Closed	_____ Open	_____ Reversed
_____ Closed	_____ Closed	_____ Reversed
_____ Open	_____ Closed	_____ Normal
_____ Open	_____ Closed	_____ Reversed

Patient-to-Line Leakage for ECG

1. Connect an ECG test body to the monitor's front panel **ECG** input. The ECG test body can be the assembly leakage cable.
2. Set the fixture's **Leakage** switch to **Line**.
3. Turn ON the monitor using the monitor's power switch.
4. Verify the following:
   - < 50 µA (100, 120, 220, 230, or 240 VAC monitors)
5. Record the patient-to-ground leakage for the following conditions:

Table 3. Patient-to-Line Leakage Conditions for ECG

Neutral	Ground	Power (Polarity)
_____ Closed	_____ Closed	_____ Normal
_____ Closed	_____ Closed	_____ Reversed
_____ Open	_____ Closed	_____ Normal
_____ Open	_____ Closed	_____ Reversed

Patient-to-Ground Leakage for IUP

1. Connect an IUP test body to the monitor's front panel **UA** input. The IUP test body can be a SensorTip transducer (wrapped in aluminum foil) or the assembly leakage cable.
2. Set the fixture's **Leakage** switch to **Patient**.
3. Turn ON the monitor using the monitor's power switch.
4. Verify the following:
   - < 50 µA (100, 120, 220, 230, or 240 VAC monitors)
5. Record the patient-to-ground leakage for the following conditions:

Table 4. Patient-to-Ground Leakage Conditions for IUP

Neutral	Ground	Power (Polarity)
_____ Closed	_____ Closed	_____ Normal
_____ Closed	_____ Open	_____ Normal
_____ Closed	_____ Open	_____ Reversed
_____ Closed	_____ Closed	_____ Reversed
_____ Open	_____ Closed	_____ Normal
_____ Open	_____ Closed	_____ Reversed

Patient-to-Line Leakage for IUP

1. Connect an IUP test body to the monitor's front panel **UA** input. The IUP test body can be a SensorTip transducer (wrapped in aluminum foil) or the assembly leakage cable.
2. Set the fixture's **Leakage** switch to **Line**.
3. Turn ON the monitor using the monitor's power switch.
4. Verify the following:
   - < 50 µA (100, 120, 220, 230, or 240 VAC monitors)
5. Record the patient-to-ground leakage for the following conditions:

Table 5. Patient-to-Line Leakage Conditions for IUP

Neutral	Ground	Power (Polarity)
_____ Closed	_____ Closed	_____ Normal
_____ Closed	_____ Closed	_____ Reversed
_____ Open	_____ Closed	_____ Normal
_____ Open	_____ Closed	_____ Reversed

Patient-to-Ground Leakage for $MSpO_2$

1. Connect an $MSpO_2$ test body to the monitor's front panel **$MSpO_2$** input. Use the assembly leakage cable for the test body.
2. Set the fixture's **Leakage** switch to **Patient**.
3. Turn ON the monitor using the monitor's power switch.
4. Verify the following:
   - < 50 µA (100, 120, 220, 230, or 240 VAC monitors)
5. Record the patient-to-ground leakage for the following conditions:

Table 6. Patient-to-Ground Leakage Conditions for $MSpO_2$

Neutral	Ground	Power (Polarity)
_____ Closed	_____ Closed	_____ Normal
_____ Closed	_____ Open	_____ Normal
_____ Closed	_____ Open	_____ Reversed
_____ Closed	_____ Closed	_____ Reversed
_____ Open	_____ Closed	_____ Normal
_____ Open	_____ Closed	_____ Reversed

Patient-to-Line Leakage for $MSpO_2$

1. Connect an $MSpO_2$ test body to the monitor's front panel **$MSpO_2$** input. Use the assembly leakage cable for the test body.
2. Set the fixture's **Leakage** switch to **Line**.
3. Turn ON the monitor using the monitor's power switch.
4. Verify the following:
   - < 50 µA (100, 120, 220, 230, or 240 VAC monitors)
5. Record the patient-to-ground leakage for the following conditions:

Table 4-1. Patient-to-Line Leakage Conditions for $MSpO_2$

Neutral	Ground	Power (Polarity)
_____ Closed	_____ Closed	_____ Normal
_____ Closed	_____ Closed	_____ Reversed
_____ Open	_____ Closed	_____ Normal
_____ Open	_____ Closed	_____ Reversed

Patient-to-Ground Leakage for US

1. Connect an US test body to the monitor's front panel **US** input. The US test body should be an ultrasound transducer wrapped in aluminum foil.
2. Set the fixture's **Leakage** switch to **Patient**.
3. Turn ON the monitor using the monitor's power switch.
4. Verify the following:
   - < 50 µA (100, 120, 220, 230, or 240 VAC monitors)
5. Record the patient-to-ground leakage for the following conditions:

Table 4-2. Patient-to-Ground Leakage Conditions for US

Neutral	Ground	Power (Polarity)
_____ Closed	_____ Closed	_____ Normal
_____ Closed	_____ Open	_____ Normal
_____ Closed	_____ Open	_____ Reversed
_____ Closed	_____ Closed	_____ Reversed
_____ Open	_____ Closed	_____ Normal
_____ Open	_____ Closed	_____ Reversed

Patient-to-Line Leakage for US

1. Connect an US test body to the monitor's front panel **US** input. The US test body should be an ultrasound transducer wrapped in aluminum foil.
2. Set the fixture's **Leakage** switch to **Line**.
3. Turn ON the monitor using the monitor's power switch.
4. Verify the following:
   - < 50 µA (100, 120, 220, 230, or 240 VAC monitors)
5. Record the patient-to-ground leakage for the following conditions:

Table 4-3. Patient-to-Line Leakage Conditions for US

Neutral	Ground	Power (Polarity)
_____ Closed	_____ Closed	_____ Normal
_____ Closed	_____ Closed	_____ Reversed
_____ Open	_____ Closed	_____ Normal
_____ Open	_____ Closed	_____ Reversed

Patient-to-Ground Leakage for US2

1. Connect an US test body to the monitor's front panel **US2** input. The US test body should be an ultrasound transducer wrapped in aluminum foil.
2. Set the fixture's **Leakage** switch to **Patient**.
3. Turn ON the monitor using the monitor's power switch.
4. Verify the following:
   - < 50 µA (100, 120, 220, 230, or 240 VAC monitors)
5. Record the patient-to-ground leakage for the following conditions:

Table 7. Patient-to-Ground Leakage Conditions for US2

Neutral	Ground	Power (Polarity)
_____ Closed	_____ Closed	_____ Normal
_____ Closed	_____ Open	_____ Normal
_____ Closed	_____ Open	_____ Reversed
_____ Closed	_____ Closed	_____ Reversed
_____ Open	_____ Closed	_____ Normal
_____ Open	_____ Closed	_____ Reversed

Patient-to-Line Leakage for US2

1. Connect an US test body to the monitor's front panel **US2** input. The US test body should be an ultrasound transducer wrapped in aluminum foil.
2. Set the fixture's **Leakage** switch to **Line**.
3. Turn ON the monitor using the monitor's power switch.
4. Verify the following:
   - < 50 µA (100, 120, 220, 230, or 240 VAC monitors)
5. Record the patient-to-ground leakage for the following conditions:

Table 8. Patient-to-Line Leakage Conditions for US2

Neutral	Ground	Power (Polarity)
_____ Closed	_____ Closed	_____ Normal
_____ Closed	_____ Closed	_____ Reversed
_____ Open	_____ Closed	_____ Normal
_____ Open	_____ Closed	_____ Reversed

Ground Continuity

Use an ohm meter to confirm continuity between the monitor's AC connector inlet ground pin and unit's chassis.

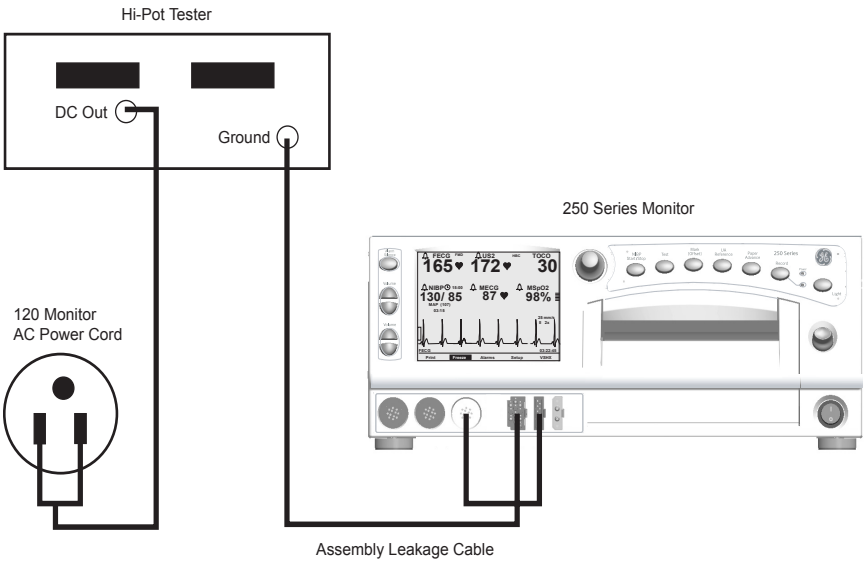
Dielectric (Hi-Pot) Tests

CAUTION
POWER OFF—Turn off the monitor prior to performing any of the hi-pot tests.

Patient–to–AC-Line Using DC Voltage for 1 Minute

Connect the monitor to the hi-pot tester as shown on in the figure below.

NOTE: The hi-pot tester voltage is 5.656 kVdc.



Patient–to–AC-Line Using DC Voltage for 1 Minute (5.656 kVdc)

- **FECG:** Connect an FECG test body to the monitor's front panel **ECG** input. The FECG test body can be the assembly leakage cable. Measure the voltage breakdown.

  ☐ pass ☐ fail

- **MECG:** Connect an ECG test body to the monitor's front panel **ECG** input. The MECG test body can be a shorted MECG cable or the assembly leakage cable. Measure the voltage breakdown.

  ☐ pass ☐ fail

- **IUP:** Connect an IUP test body to the monitor's front panel **UA** input. The IUP test body can be a SensorTip cable (wrapped in aluminum foil) or the assembly leakage cable. Measure the voltage breakdown.

  ☐ pass ☐ fail

- **$MSpO_2$:** Connect an $MSpO_2$ test body to the monitor's front panel **$MSpO_2$** input. The $MSpO_2$ test body can be an $MSpO_2$ cable and sensor (wrapped in aluminum foil) or the assembly leakage cable. Measure the voltage breakdown.

  ☐ pass ☐ fail

- **US:** Connect an US test body to the monitor's front panel **US** input. The US test body should be an ultrasound transducer wrapped in aluminum foil. Measure the voltage breakdown.

  ☐ pass ☐ fail

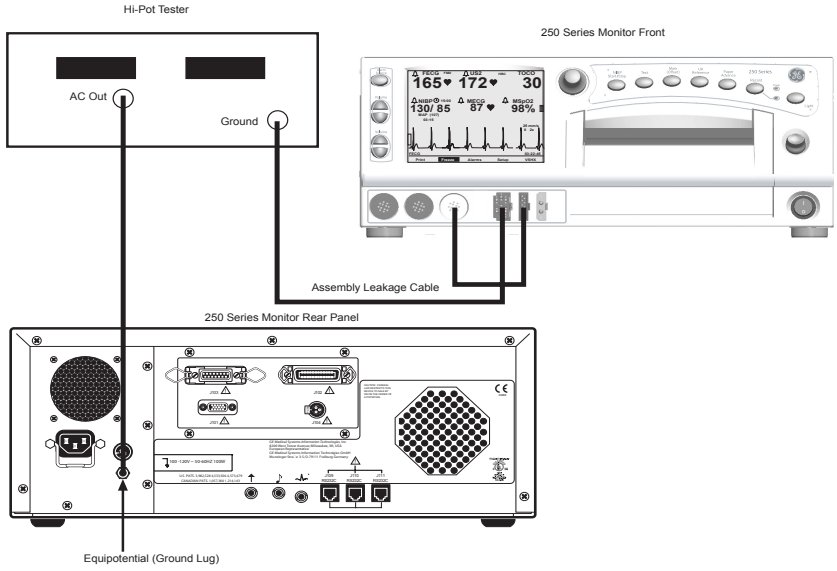
- **US2:** Connect an US test body to the monitor's front panel **US2** input. The US test body should be an ultrasound transducer wrapped in aluminum foil. Measure the voltage breakdown.

  ☐ pass ☐ fail

Patient–to–Chassis Using AC Voltage for 1 Minute

Connect the monitor to the hi-pot tester as shown below.

NOTE: The hi-pot tester voltage is 2.5 kVAC.



Patient–to–Chassis Using AC Voltage for 1 Minute (2.5 kVAC)

- **FECG:** Connect an FECG test body to the monitor's front panel **ECG** input. The FECG test body can be the assembly leakage cable. Measure the voltage breakdown.

  ☐ pass ☐ fail

- **MECG:** Connect an ECG test body to the monitor's front panel **ECG** input. The MECG test body can be a shorted MECG cable or the assembly leakage cable. Measure the voltage breakdown.

  ☐ pass ☐ fail

- **IUP:** Connect an IUP test body to the monitor's front panel **UA** input. The IUP test body can be a SensorTip cable (wrapped in aluminum foil) or the assembly leakage cable. Measure the voltage breakdown.

  ☐ pass ☐ fail

- **$MSpO_2$:** Connect an $MSpO_2$ test body to the monitor's front panel **$MSpO_2$** input. The $MSpO_2$ test body can be an $MSpO_2$ cable and sensor (wrapped in aluminum foil) or the assembly leakage cable. Measure the voltage breakdown.

  ☐ pass ☐ fail

- **US:** Connect an US test body to the monitor's front panel **US** input. The US test body should be an ultrasound transducer wrapped in aluminum foil. Measure the voltage breakdown.

  ☐ pass ☐ fail

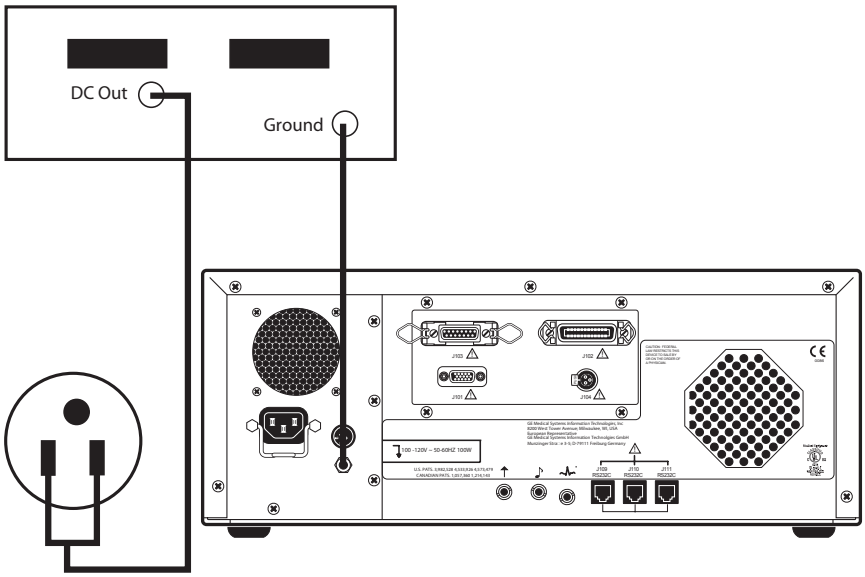
- **US2:** Connect an US test body to the monitor's front panel **US2** input. The US test body should be an ultrasound transducer wrapped in aluminum foil. Measure the voltage breakdown.

  ☐ pass ☐ fail

Mains–to–Chassis Using DC Voltage for 1 Minute

Connect the monitor to the hi-pot tester as shown in the following figure.

NOTE: The hi-pot tester voltage is 2.121 kVdc.



Mains-to-Chassis Using DC Voltage for 1 Minute

Checkout

General

Like all electronic monitoring devices, internal and external components are subject to fatigue, wear, and the potential for failure over time and under varying conditions of use. Additionally, events such as dropping the monitor, spilling liquids on the monitor, or crimping the lead wires or patient cables can cause damage which may affect the overall system performance. Therefore, between factory service visits it is necessary that the proper operation of each monitor be verified by performing the functional checkout procedure described in this section. This procedure should be completed prior to initially placing the monitor on a patient, when monitor performance needs to be verified, on a semi-annual basis, or more frequently as dictated by your equipment maintenance and management policies.

Equipment Required

The following items are necessary for performing any of the tests in this procedure:

- Corometrics Model 325 Simulator and corresponding line cord
- 250 Series Monitor interconnect cables
- Ultrasound Transducers (x2)
- Tocotransducer
- Strain Gauge Transducer

Self-Test Routine

The 250 Series Monitor contains test routines which verify the unit's calibration and internal circuitry. These routines are initiated by depressing the front panel **Test** button. The test results are printed on the strip chart recorder paper, verifying the integrity of the unit.

It is recommended practice to initiate the self-test feature at the beginning of each monitoring session.

1. Check the Voltage Selection switch on the rear panel of the 250 Series Monitor and ensure it matches the line voltage of the connector to be used. Connect the detachable line cord to the rear panel power entry module; plug the other end into a hospital grade, grounded wall outlet of appropriate voltage.
2. Place the front panel Power switch in the *on* (**I**) position. When the power is first turned on, verify that two tones are emitted from the rear panel speaker and the green power on indicator is lit.
3. Depress the front panel **Test** button and verify the following:
   - All display pixels illuminate for 1 second and then all are extinguished for 1 second. Afterwards, a horizontal line moves across the screen from top to bottom, followed by a vertical line moving from left to right.
   - The yellow Record indicator illuminates.

NOTE: The message *TEST: ARE ALL DOTS PRINTED?* prints followed by two lines which should appear continuous. Discontinuous lines may be an indication of damaged printhead elements or dust and debris accumulated under the printhead if gaps occur in the same place on both lines. Simulated trends of 30 and 240 bpm (or 50 and 210 bpm, depending on the paper installed) are printed on the top grid. Simulated pressure trends at 0 and 100 mmHg are printed on the bottom grid.

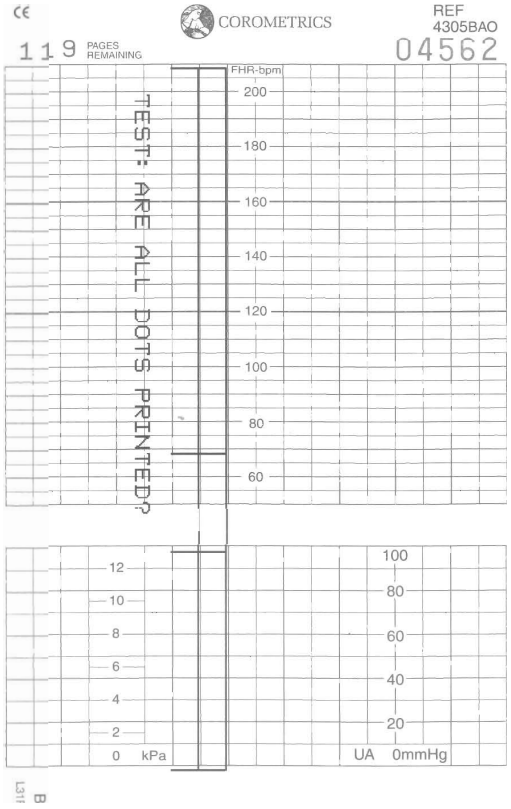
   - After the recorder test above, the display returns to the main screen; then the software generates a 120 bpm rate in the FHR1 area and a 180 bpm rate in the FHR2 area, with both mode titles displaying *Test.*
   - The monitor adds 50 mmHg to the present pressure input level and displays this value in the UA display area; the mode title displays *Test.*
   - If MECG is the selected waveform, a simulated waveform appears on the display.

NOTE: The monitor will add 50 mmHg to raw pressure data. In other words, the value is always referenced to 0 mmHg regardless of any UA referencing attempt.

NOTE: The recorder returns to its original on, off, or maternal-only mode state from when the **Test** button was depressed.

NOTE: To disable the test, depress the **Test** button or open the recorder door.

NOTE: If the simulated fetal heart rate trends do not appear in the correct positions on the strip chart recorder paper, ensure the monitor's paper scale (*30-240 bpm* or *50-210 bpm*) setting matches the type of paper being used, i.e., 30 bpm/cm or 20 bpm/cm. (Refer to"Install Options Screens" on page 3-14.)



250 Series Self-Test

Front Panel Button Test

This procedure ensures the functionality of the front panel buttons.

1. Apply power to the 250 Series Monitor.
2. Disconnect all transducers from the front panel.
3. Depress the monitor's **Record** button and verify the following:
   - The yellow indicator next to the button illuminates continuously.
   - The recorder paper should advance at a rate of 1 cm/min.
   - The recorder prints the correct time and date information on the strip chart paper. (If an incorrect time or date is listed, refer to "Setup" on page 3-9 in this manual.)
   - The recorder prints the messages *CARDIO INOP* and *UA INOP,* indicating that no ultrasound, ECG, or uterine activity transducers are plugged into the front panel **US**, **US2**, **FECG/MECG**, or **UA** connectors.
   - The recorder prints the message *1 cm/min*, indicating the selected chart speed.
4. Depress and hold the monitor's front panel **Paper Advance** button and verify that the recorder paper advances at a rate of 40 cm/min by measuring.
5. Release the **Paper Advance** button and verify that the recorder prints the message *1 cm/min* by measuring.
6. Access the *Install Options Screen 1* again, and follow Steps 3 - 6, performing the same tests on the other two options: *2 cm/min* and *3 cm/min.*
7. Depress the monitor's front panel **Mark [Offset]** button and verify that an event mark (↑) is printed on the lowest portion of the HR scale on the recorder paper.

Connecting the Simulator

This part of the procedure prepares the simulator for use.

NOTE: You must use a Model 325 Simulator and 1442AAO cable "Y" adapter for the functional checkout procedure. (305 simulators do not work with the 250 Series.)

1. Ensure the Model 325 **Power** switch is in the *off* position.
2. Connect the Model 325 Simulator's power cord to the power connector on the rear panel of the simulator; plug the other end of the power cord into a properly grounded wall outlet of appropriate voltage.
3. Ensure the 250 Series Monitor Power switch is in the *off* position.
4. Connect the simulator interconnect cable's 50-pin end to the simulator's **Fetal Monitor** connector.
5. Insert the green plug of the FECG/MECG adapter cable, cat. no. (REF) 1442AAO, into the monitor's **FECG/MECG** connector.

6. Connect the sub-cables of the other end of the simulator interconnect cable into the color-coded connectors on the monitor/adapter: **ECG**, **US**, and **UA**.
7. Turn *on* the Model 325 Simulator. Verify that the green **Power** indicator illuminates.
8. Turn *on* the 250 Series Monitor.

MECG Test

This portion of the functional checkout procedure ensures the integrity of the MECG circuitry and the heart rate channel of the recorder.

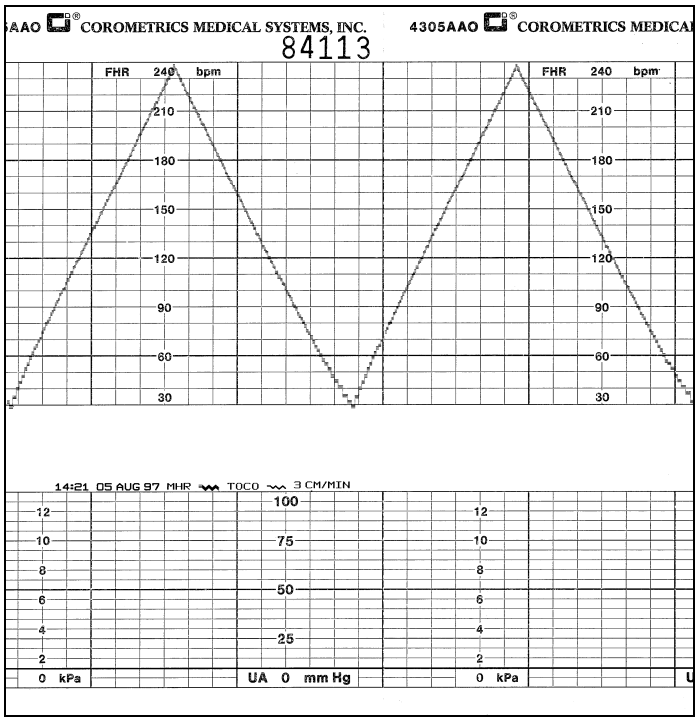
1. Connect the simulator's ECG cable to the **MECG** connector on the monitor adapter cable (1442AAO).
2. Connect the simulator's UA cable to the **UA** connector on the monitor.
3. Set the switches on the Model 325 Input Simulator according to Table 9.
4. If not already on, depress the monitor's **Record** button.
5. Turn the simulator's **Manual Adjustment** knob counterclockwise and verify the following on the monitor's display until the monitor reads a value of 30 bpm:
   - The MHR/P mode is **MECG**.
   - The MHR heartbeat indicator (♥) flashes at a rate of 30 times per minute.
   - The UA mode is **TOCO**.
6. Access the *Install Options Screen 2* and note the *Default TOCO Reference* value. Exit the service mode by selecting *Restart* at the bottom of the screen.
7. After the monitor restarts, press the monitor's front panel **UA Reference** button.
8. Verify the following on the monitor:
   - The UA value is referenced to the default value.
   - The recorder prints a continuous line at the default value on the bottom grid of the strip chart paper.
   - The recorder prints the message **UA REF** on the strip chart paper.
9. Turn the simulator's **Manual Adjustment** knob until the monitor displays an MECG signal of approximately 60 bpm. Verify the following on the monitor:
   - The MHR value is 60 bpm.
   - The MHR heartbeat indicator (♥) flashes at a rate of 60 times per minute (1 per second).
   - The ECG "beep" volume can be heard from the rear panel speaker. The volume can be adjusted on the MHR/P Setup screen.
   - Or using the **Volume** increase/decrease buttons, set *HR/PR Trace* to *On* in the *MHR/P Setup* screen The recorder should print a continuous line at 60 bpm on the top grid of the strip chart paper.

Table 9. MECG Test Simulator Settings		
Section	**Switch**	**Setting**
FECG/MECG	Rate/CMR	RATE
	Rate	MANUAL
	Mode	MECG
	QRS Amplitude	500 µV
	QRS Polarity	+
GENERAL	Pattern Memory	*Off*
UA	Main	CMR
	Mode	TOCO

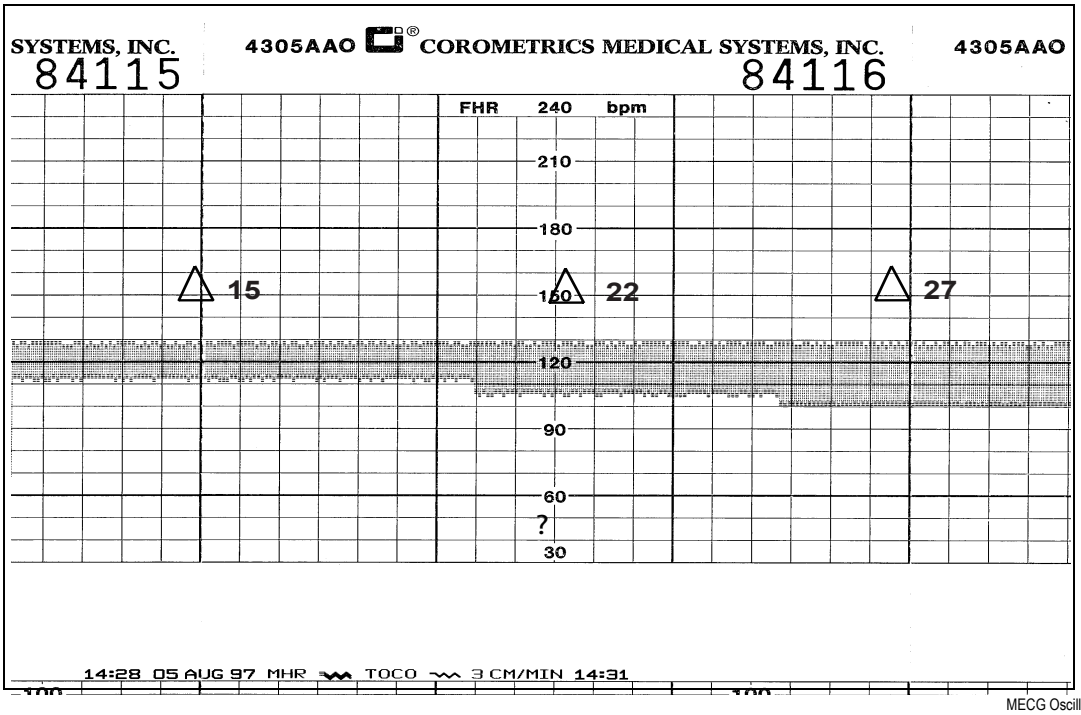
10. Repeat Step 9 for each of the following rates: 30, 120, 210, and 240 bpm.
11. Change the simulator's **QRS Polarity** switch from + to –. Verify that the monitor does not skip any beats.
12. Set the simulator's **ECG Rate** switch to the RAMP setting. Verify that the monitor's MHR value counts between approximately 30 and 240 bpm and that the recorder prints a ramp between the same values. (Refer to figure on "MECG Ramp" on page 4-25.)
13. Set the simulator's **ECG Rate** switch to the Δ15 position. Verify the following on the monitor:
    - The MHR value alternates between two rates 15 bpm apart on the recorder printout.
    - The MHR heartbeat indicator (♥) flashes for each input signal.
    - The ECG "beep" is heard from the rear panel speaker; the volume can be adjusted on the *MHR/P Setup* screen.
    - The recorder prints an oscillation of 15 bpm between 110 and 125 bpm on the top grid of the strip chart paper. (Refer to "MECG Oscillation" on page 4-25.)
    - Repeat Step 13 for rate values of Δ22 and Δ27. The results should be the same except that the MHR value alternates between two rates 22 bpm or 27 bpm apart and the recorder prints an oscillation of 22 or 27 bpm. The top value is always at approximately 125 bpm. (Refer to "MECG Oscillation" on page 4-25.)

- Set the simulator's **ECG Rate** switch to the MANUAL position and the **Manual Adjustment** knob to the counterclockwise position. Disconnect the ECG simulator cable from the monitor's y-adapter cable. Verify the following on the monitor:
  - The *MHR/P* value and *Pulse* mode are both blank.
  - The recorder stops printing maternal heart rate data on the strip chart paper.
  - The recorder prints the message *CARDIO INOP* on the center margin of the strip chart paper after approximately 30 seconds.

14. Set the simulator's **ECG Mode** switch to the *Off* position.



MECG Ramp



MECG Oscillation

FECG Test

This portion of the functional checkout procedure ensures the integrity of the FECG circuitry and the heart rate channel of the recorder.

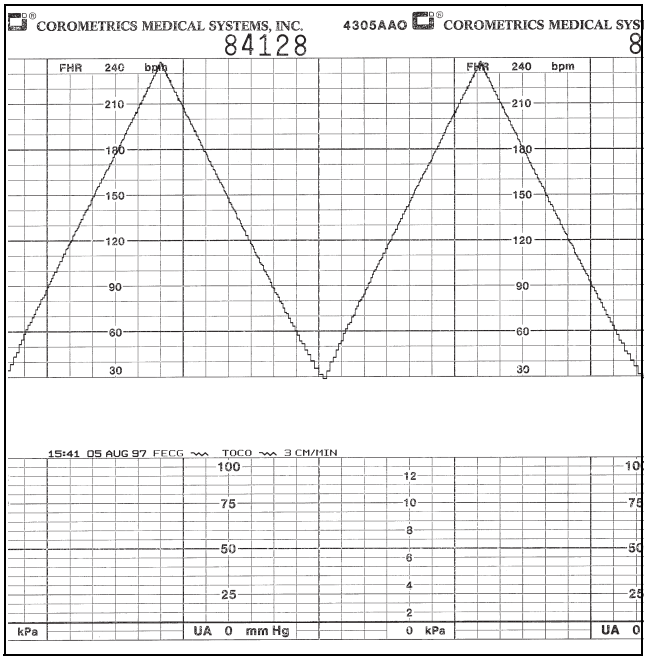
1. Connect the simulator's ECG cable to the **FECG** connector on the monitor's "Y" adapter cable.
2. Connect the simulator's UA cable to the **UA** connector on the monitor.
3. Set the switches on the Model 325 Input Simulator according to Table 9.
4. If not already on, depress the monitor's **Record** button.
5. Turn the simulator's **Manual Adjustment** knob counterclockwise and verify the following on the monitor's display:
   - The FECG value is 30 bpm.
   - The FECG mode is **FECG**.
   - The FECG heartbeat indicator (♥) flashes at a rate of 30 times per minute.
   - The UA mode is **TOCO**.
6. Depress and hold the monitor's **UA Reference** button and release when the UA value shows 10 relative units in mmHg mode or 1.3 kPa in kPa mode. Verify the following on the monitor:
   - The UA value is referenced to 10 mmHg (1.3 kPa) on the display.
   - The recorder prints a continuous line at 10 mmHg (1.3 kPa) on the bottom grid of the strip chart paper.
   - The recorder prints the messages **UA REF** on the strip chart paper.
7. Turn the simulator's **Manual Adjustment** knob to input an FECG signal of approximately 120 bpm. Verify the following on the monitor:
   - The FECG value is 120 bpm.
   - FECG heartbeat indicator (♥) flashes at a rate of 120 times per minute.
   - The ECG "beep" volume of the rear panel speaker can be increased or decreased using the left pair of **Volume** buttons. (Set the volume to the desired level.)
   - The recorder prints a continuous line at 120 bpm on the *HR* grid of the strip chart paper.

Table 10. FECG Test Simulator Settings		
Section	**Switch**	**Setting**
FECG/MECG	Rate/CMR	RATE
	Rate	MANUAL
	Mode	FECG
	QRS Amplitude	15 µV
	QRS Polarity	+
GENERAL	Pattern Memory	*Off*
UA	Main	CMR
	Mode	TOCO

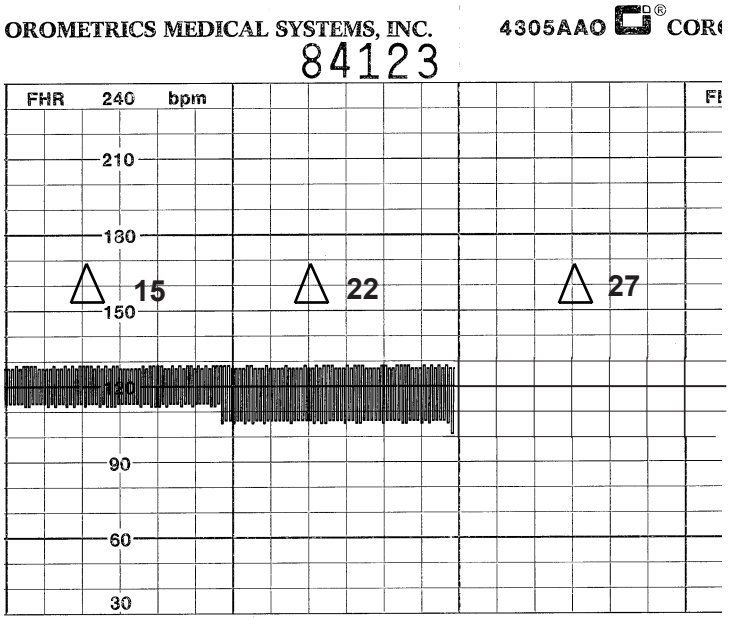
8. Repeat Step 7 for each of the following rates: 30, 60, 210, and 240 bpm.
9. Change the simulator's **QRS Polarity** switch from + to –. Verify that the monitor does not skip any beats.
10. Set the simulator's **ECG Rate** switch to the RAMP setting. Verify that the monitor's FECG value counts between approximately 30 and 240 bpm and that the recorder prints a ramp between the same values. (Refer to "FECG Ramp" on page 4-28.)
11. Access *Install Options Screen 2* and set ECG Artifact Elimination to *Off*; then exit the service mode by selecting *Restart* at the bottom of the screen.
12. Set the simulator's **ECG Rate** switch to the Δ15 position. Verify the following on the monitor:
    - The FECG value alternates by 15 bpm.
    - The FHR1 heartbeat indicator (♥) flashes for each input signal.
    - The ECG "beep" is heard from the rear panel speaker.
    - The recorder prints an oscillation of 15 bpm between 110 and 125 bpm on the top grid of the strip chart paper. (Refer to "FECG Artifact Elimination" on page 4-29.
13. Repeat Step 12 for rates values of Δ22 and Δ27. The results should be the same except that the FHR1 value alternates by either 22 or 27 bpm and the recorder prints an oscillation of 22 or 27 bpm. The top value is always at approximately 125 bpm. (Refer to figure "FECG Artifact Elimination" on page 4-29.)
14. Access *Install Options Screen 2* and set the *FECG Artifact Elimination* to *On*.
15. Set the simulator's **ECG Rate** switch to the Δ15 position. Verify the following on the monitor:
    - The FHR1 value alternates by 15 bpm.
    - The FHR1 heartbeat indicator (♥) flashes for each input signal.
    - The ECG "beep" is heard from the rear panel speaker.

- The recorder prints an oscillation of 15 bpm between 110 and 125 bpm on the top grid of the strip chart paper. (Refer to figure "FECG Artifact Elimination" on page 4-29.)

16. Repeat Step 15 for the rate value of Δ22. The result should be the same as Step 15 except that the FHR1 value alternates between 22 bpm and the recorder prints an oscillation of 22 bpm between the 103 and 125 bpm on the strip chart recorder paper.
17. Set the simulator's **ECG Rate** switch to the Δ27 position. Verify the following on the monitor:
    - The FHR1 value oscillates by 27 bpm.
    - The FHR1 heartbeat indicator (♥) flashes for each input signal.
    - The ECG "beep" is heard from the rear panel speaker.
    - The recorder does not print any oscillation.
18. Access *Install Options Screen 2* and set the *FECG Artifact Elimination* back to *Off*.
19. Set the simulator's **ECG Rate** switch to the MANUAL position and the **Manual Adjustment** knob to the counterclockwise position. Disconnect the ECG simulator cable from the monitor's y-adapter cable. Verify the following on the monitor:
    - The FHR1 value and mode are both blank.
    - The recorder stops printing heart rate data on the strip chart paper.
    - The recorder prints the message *CARDIO INOP* on the center margin of the strip chart paper after approximately 30 seconds.
    - Set the simulator's **ECG Mode** switch to the *Off* position.



FECG Ramp



FECG Artifact Elimination

Ultrasound Test

This portion of the functional checkout procedure ensures the integrity of the ultrasound circuitry and the heart rate channel of the recorder.

1. Connect the simulator's US cable to the **US** connector on the monitor.
2. Set the switches on the Model 325 Input Simulator according to Table 11.
3. If not already on, depress the monitor's **Record** button.
4. Turn the simulator's **Manual Adjustment** knob to input an ultrasound signal of approximately 120 bpm. Verify the following on the monitor:
   - The FHR1 value is 120 bpm.
   - The FHR1 mode is **US**.
   - The FHR1 heartbeat indicator (♥) flashes at a rate of 120 times per minute.
   - Ultrasound audio volume from the rear panel speaker can be increased or decreased using the upper-left pair of **Volume** buttons. (Set the volume to the desired level.)
   - The recorder prints a continuous line at 120 bpm on the top grid of the strip chart paper.
   - The recorder prints the message *US* on the center margin of the strip chart paper after approximately 20 seconds.
5. Use the simulator's **Manual Adjustment knob** to increase the heart rate value by less than 13 bpm from the 120 bpm baseline. Verify the following on the monitor:
   - The FHR1 value immediately reflects this new input rate.
   - The strip chart recorder immediately reflects this new input rate.

6. Use the simulator's **Manual Adjustment** knob to decrease the heart rate value by more than 13 bpm from the 120 bpm baseline. Verify the following on the monitor:
   - The FHR1 value immediately reflects this new input rate.
   - The strip chart recorder prints at the last input rate for an additional 3 seconds before blanking the heart rate data and printing a continuous line at the new input rate.

7. Set the simulator's **US Rate** switch to the RAMP position. Verify that the FHR1 value counts between approximately 50 and 210 bpm and that the recorder prints a ramp between the same values. (Refer to figure "Ultrasound Ramp" on page 4-31.)

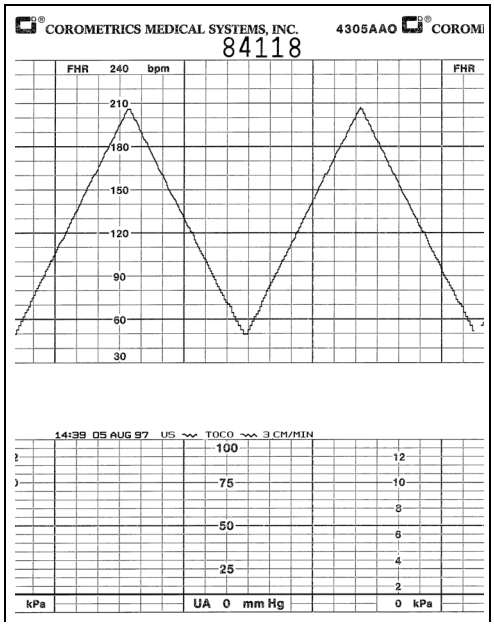
Table 11. Ultrasound Test Simulator Settings

Section	Switch	Setting
US/FMD	Mode	US
	Signal Level	MED
	Rate	MANUAL
GENERAL	Pattern Memory	*Off*
UA	Main	CMR
	Mode	TOCO

8. Place the simulator's **US Rate** switch in each of the individual rate settings (50, 60, 120, and 210 bpm). Verify the following on the monitor:
   - The FHR1 value reflects the simulator setting ± 1 bpm.
   - The FHR1 heartbeat indicator (♥) flashes at the simulator setting.
   - Ultrasound audio is heard coming from the rear panel speaker.
   - The recorder prints a continuous line at the respective value ± 3 bpm on the top grid of the strip chart paper.

9. Repeat Step 4 through Step 8 using the second ultrasound channel. (The mode will show **US2**.)

10. Place the simulator's **US Mode** switch in the *Off* position. Verify the following on the monitor:
    - The FHR1 value and mode are both blank.
    - The recorder stops printing the fetal heart rate trace.
    - The recorder prints the message *CARDIO INOP* on the center margin of the strip chart paper after approximately 20 seconds.



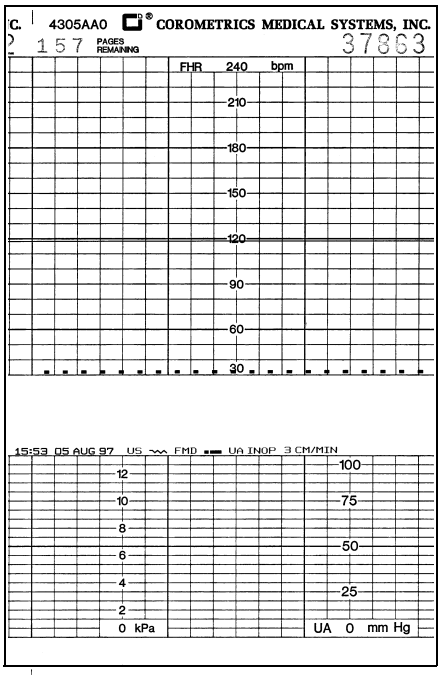
Ultrasound Ramp

Fetal Movement Detection Test

This portion of the functional checkout procedure ensures the integrity of the fetal movement detection circuitry and the heart rate channel of the recorder. (Refer to figure "Fetal Movement Detection" on page 4-32.)

1. Connect the simulator's US cable to the **US** connector on the monitor. Select the FHR2 mode field. Ensure *FM Detect* is *On*.
2. Set the switches on the Model 325 Input Simulator according to Table 12.
3. If not already on, depress the monitor's **Record** button.
4. Turn the simulator's **Manual Adjustment** knob to input an ultrasound signal of approximately 120 bpm. Verify the following on the monitor:
   - The FHR1 value is 120 bpm.
   - The FHR1 mode is **US**.
   - The **FMD** indication displays in between the FHR1 and FHR2 mode title locations if alerts are not enabled.
   - The FHR1 heartbeat indicator (♥) flashes at a rate of 120 times per minute.
   - Ultrasound audio volume from the rear panel speaker can be increased or decreased using the upper-left pair of **Volume** buttons. (Set the volume to the desired level.)
   - The recorder prints a continuous line at 120 bpm on the top grid of the strip chart paper.
   - Fetal movement markers - — are shown on for a duration of 1 second, then off for 8 seconds, then on for 1 second, etc.
   - The recorder prints the messages **US** and **FMD** - — on the center margin of the strip chart paper after approximately 20 seconds.

Table 12. Fetal Movement Detection Test Simulator Settings		
Section	**Switch**	**Setting**
Ultrasound/FMD	Mode	US/FMD
	Signal Level	MED
	Rate	MANUAL
UA	Main	CMR
	Mode	TOCO



Fetal Movement Detection

Ultrasound Transducer Test

1. Inspect an ultrasound transducer as follows:
   - Ensure there are no cracks around the transducer face.
   - Visibly inspect the condition of the cable, strain relief, and connector pins.
2. Disconnect the simulator's ultrasound cable from the front panel of the 250 Series Monitor.
3. Connect the ultrasound transducer to either the **US** or **US2** input connector on the front panel of the monitor. Verify the following on the monitor:
   - The FHR1 value shows three steady dashes "– – –."
   - The FHR1 mode is **US**.

- The recorder prints the message *US* on the center margin of the strip chart paper after approximately 20 seconds.

4. Gently rub each crystal of the ultrasound transducer rhythmically. (There are nine crystals. Eight are arranged around the circumference of the transducer; one is in the center.) Verify the following:
   - Good sensitivity is apparent.
   - The monitor's FHR1 value follows the input rate.
   - The recorder follows the input rate.
   - The FHR1 heartbeat indicator (♥) flashes for each input.
   - The FHR1 mode shows **US**.
   - Ultrasound audio is heard coming from the monitor's rear panel speaker.

5. Disconnect the ultrasound transducer from the front panel of the monitor. Verify the following on the monitor:
   - The FHR1 value, *INOP* mode, and heartbeat indicator are all blank.
   - The recorder stops printing the fetal heart rate trace.
   - The recorder prints the message *CARDIO INOP* on the center margin of the strip chart paper after approximately 20 seconds.

Uterine Activity Test

This portion of the functional checkout procedure tests the uterine activity section of the 250 Series Monitor.

1. Set the switches on the Model 325 Simulator according to Table 13, "Uterine Activity Test Simulator Settings," on page 4-34.
2. Connect the simulator's UA cable to the **UA** connector on the monitor.
3. Access the *Install Options Screen 2* and select *Pressure units*: *mmHg* mode.
4. Access the *Install Options Screen 2* and note the *Default TOCO Reference* value. (The monitor is shipped from the factory with this value set at 10 mmHg (1.3 kPa); however, your unit may have been custom configured.) Exit the service mode by selecting *Restart* at the bottom of the screen.
5. If not already on, depress the monitor's **Record** button.
6. Briefly press the monitor's **UA Reference** button. Verify the following on the monitor:
   - The UA value is the *default* setting.
   - The UA mode is **TOCO**.
   - The recorder prints a continuous line at the *default* value on the uterine activity channel of the strip chart paper.
   - The recorder prints the messages *UA REF* on the strip chart paper.
7. Press and hold the **UA Reference** button on the monitor to cycle through the available selections for *UA reference: 5, 10, 15, 20,* or 25 relative units in mmHg mode. Test each of these reference settings. Verify that the UA value is

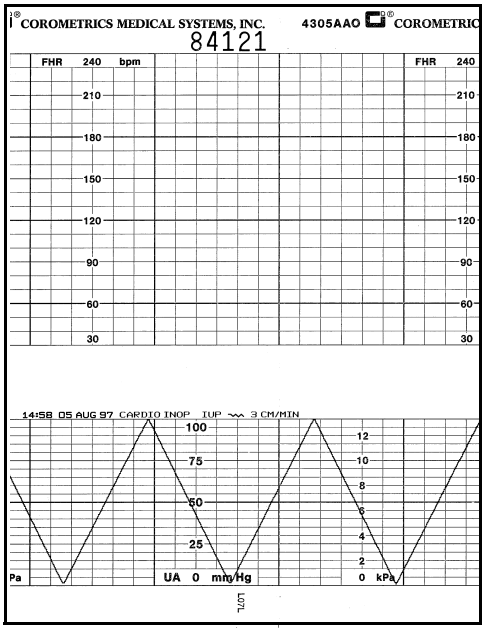
displayed accordingly and that the recorder prints a continuous line at the corresponding value on the uterine activity channel of the strip chart paper.

8. Place the simulator's **UA Level** switch at each of the level settings: 0, 10, 50, and 100 relative units. Verify that the UA value is displayed accordingly and that the recorder prints a continuous line at the corresponding value on the heart rate channel of the strip chart paper.
9. Place the simulator's **UA Mode** switch in the IUP position and the **UA Level** switch to 0 mmHg/kPa. Depress the monitor's **UA Reference** button and verify that the monitor and recorder reference to 0 mmHg/kPa. Verify the following on the monitor:
   - The UA value is 0 mmHg.
   - The UA mode is **IUP**.
   - The recorder prints a continuous line at 0 mmHg on the uterine activity channel of the strip chart paper.
   - The recorder prints the messages *UA REF* on the strip chart paper.

Table 13. Uterine Activity Test Simulator Settings

Section	Switch	Setting
UA	Pattern Memory	*Off*
	Main	LEVEL
	Level	0 mmHg
	Mode	TOCO

10. Place the simulator's **UA Level** switch at each of the level settings: 0, 10, 50, and 100 mmHg. Verify that the UA value is displayed accordingly and that the recorder prints a continuous line at the corresponding value on the uterine activity channel of the strip chart paper.
11. Place the simulator's **UA Level** switch to the RAMP position. Verify that the UA value measures between approximately 0 and 100 mmHg and that the recorder prints a ramp between the same values. Refer to figure "Uterine Activity Ramp" on page 4-35.
12. Disconnect the Model 325 simulator's **UA** cable from the **UA** input connector on the front panel of the monitor. Verify the following on the monitor:
    - The UA value and IUP are both blank.
    - The recorder stops printing the uterine activity trace.
    - The recorder prints the message *UA INOP* on the center margin of the strip chart paper after approximately 20 seconds.



Uterine Activity Ramp

Testing the Tocotransducers

CAUTIONS

LEAKAGE TEST—Perform a leakage and dielectric test on the tocotransducer per applicable standards.

FUNCTIONAL TEST—Perform a functional response test on the tocotransducer. Inspect a Nautilus Tocotransducer as follows:

1. Check for any cracks or contaminants on the tocotransducer especially on the diaphragm located on the bottom of the tocotransducer. Visibly inspect the condition of the cable, strain relief, and connector pins.
2. Connect the tocotransducer to the **UA** input connector on the front panel of the 250 Series Monitor.

IMPORTANT

TRIMLINE TOCOTRANSDUCER—If you are using an older Trimline tocotransducer for this test, be advised of the following. If the monitor is *on* when you connect or re-connect a Trimline Tocotransducer to the **UA** connector, you ***must*** wait at least 10 seconds before pressing the **UA Reference** button. If the monitor is *off*, you ***must*** wait at least 10 seconds from the time the monitor is powered *on*.

3. Access the *Install Options Screen 2* and note the *Default TOCO Reference* setting. Exit the service mode by selecting *Restart* at the bottom of the screen.

4. Momentarily depress the monitor's **UA Reference** button. Verify the following:
   - The UA value shows the *default* setting.
   - The UA mode shows **TOCO**.
   - The recorder prints the messages *UA REF* and *TOCO* on the strip chart paper.
5. Apply gentle pressure to the tocotransducer diaphragm and verify that the UA value responds to the pressure input. Increasing force should produce an increasing value and vice versa.
6. Remove the tocotransducer from the monitor's **UA** input connector. Verify the following on the monitor:
   - The UA value and INOP are both blank.
   - The recorder stops printing the uterine activity trace.
   - The recorder prints the message *UA INOP* on the center margin of the strip chart paper after approximately 20 seconds.

Strain Gauge Transducer Test

1. Inspect a strain gauge as follows:
   - Unscrew the plastic dome from the transducer and check for any cracks or contaminants on the transducer.
   - Visibly assess the condition of the cable, strain relief, and the connector pins.
2. Connect the strain gauge to the **UA** input connector on the front panel of the 250 Series Monitor. Verify the following on the monitor:
   - The UA value may read negative numbers indicating baseline pressure is off scale. In this case, the recorder prints the message *BASELINE PRESSURE OFFSCALE* on the bottom of the *UA* scale on the strip chart paper.
   - The UA mode is **IUP** for intrauterine pressure.
   - The recorder prints the message *IUP* on the center margin of the strip chart paper after approximately 20 seconds.
3. Depress the monitor's **UA Reference** button and verify the following on the monitor:
   - The UA value is 0 mmHg (0 kPa).
   - The recorder prints a continuous line at 0 mmHg (0 kPa) on the strip chart paper.
   - The recorder prints the message *UA REF* on the bottom two lines of the top grid of the strip chart paper.
4. Apply gentle pressure on the strain gauge diaphragm and verify that the display and recorder respond to the input. Increasing force should produce an increasing value and vice versa.
5. Disconnect the strain gauge from the front panel of the monitor. Verify the following on the monitor:

- The UA value and mode are both blank.
- The recorder stops printing the uterine activity trace.
- The recorder prints the message *UA INOP* on the center margin of the strip chart paper after approximately 20 seconds.

Pattern Memory Test

The pattern memory of the simulator can be used to test any of the following mode combinations of the monitor.

- FECG/TOCO
- FECG/IUP
- MECG/TOCO
- MECG/IUP
- US/TOCO
- US/IUP
- US/FMD/TOCO
- US/FMD/IUP
- US2/TOCO
- US2/IUP
- FECG/US/TOCO
- FECG/US/IUP
- FECG/US2/TOCO
- FECG/US2/IUP
- US/TOCO/MECG
- US/IUP/MECG
- US2/TOCO/MECG
- US2/IUP/MECG

NOTE: US/US2 cannot be tested simultaneously unless two Model 325 Simulators Model 250 Series ultrasound transducers are used. Do not attempt to test dual ultrasound using one Model 325 Simulator and one ultrasound transducer or a conflict between enable lines will occur.

NOTE: FECG/MECG cannot be tested simultaneously unless two Model 325 Simulators are used.

NOTE: Although dual heart rate can be verified using the pattern memory, an additional procedure is given in this functional checkout procedure.

To check any of the mode combinations listed above:

1. Connect the appropriate simulator sub-cables to the corresponding connectors on the monitor.
2. Enable the modes on the simulator.
3. Set the simulator's **Pattern Memory** switch to the ON position.
4. If not already on, depress the monitor's **Record** button.

5. Verify the following on the monitor:
   - Each heart rate area (FHR1, FHR2, and/or MECG) responds accordingly for value, mode, and heartbeat indicator.
   - The UA area responds accordingly for value and mode.
   - The recorder responds appropriately in both trending and message information.

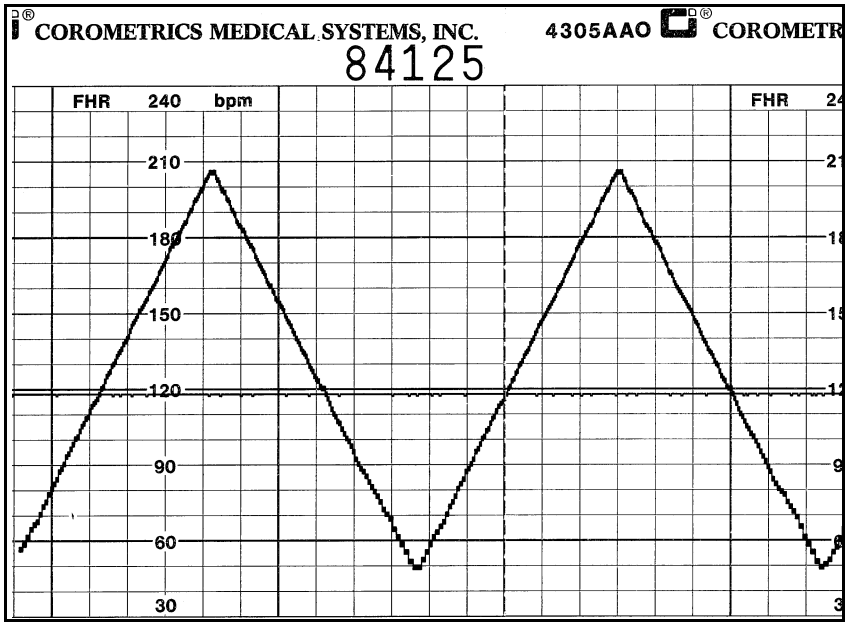
NOTE: Refer to the *Model 325 Simulator Product Manual* for illustrations of the patterns to be expected on the monitor.

Dual Heart Rate Test (Non-Pattern)

FECG/US Modes

1. Connect the FECG/MECG adapter cable to the **FECG/MECG** connector on the 250 Series Monitor.
2. Connect the Model 325 Simulator's ECG cable to the **FECG** input on the monitor's "Y" adapter cable.
3. Connect the simulator's US cable to the monitor's **US** input connector.
4. Set the switches on the Model 325 Simulator according to Table 14.
5. If not already on, depress the monitor's **Record** button.
6. Verify the following on the monitor:
   - The FHR1 value reads 120 bpm ± 1 bpm.
   - The FHR1 mode reads **FECG**.
   - The FHR1 heartbeat indicator (♥) flashes at a rate of 120 times per minute.
   - The FHR2 value varies between approximately 50 and 210 bpm.
   - The FHR2 mode reads **US**.
   - The FHR2 heartbeat indicator (♥) flashes at a rate consistent with the value.
   - The recorder prints the messages *FECG* and *US* on the center margin of the strip chart paper.
   - The recorder prints a continuous plain black line (⌐⩘⩘) on the 120 bpm mark on the heart rate channel of the strip chart paper. (Refer to "Dual Heart Rate, FECG and US" on page 4-39.)
   - The recorder prints a bold black ramp trace (⌐⩘) between 50 and 210 bpm on the heart rate channel of the strip chart paper. (Refer to "Dual Heart Rate, FECG and US" on page 4-39.)

Table 14. Dual Heart Rate Test (Non-Pattern) Simulator Settings		
Section	**Switch**	**Setting**
FECG/MECG	Rate/CMR	RATE
	Rate	120 bpm
	Mode	FECG
	QRS Amplitude	50 µV
	QRS Polarity	+
ULTRASOUND/FMD	Mode	US
	Level	MED
	Rate	RAMP
GENERAL	Pattern Memory	*Off*



Dual Heart Rate, FECG and US

Dual Ultrasound Modes

1. As stated previously, the dual ultrasound mode of the 250 Series Monitor cannot be tested unless two Model 325 Simulators are used or two Model 250 Series ultrasound transducers. ***Do not*** attempt to test dual ultrasound using one Model 325 Simulator and one ultrasound transducer. This procedure details using two transducers since it is more practical for a test site.
2. If not already on, depress the monitor's **Record** button.

3. Plug one ultrasound transducer into the monitor's **US** input connector and the other into the monitor's **US2** connector. Verify the following on the monitor:
   - The FHR1 mode shows **US**.
   - The FHR2 mode shows **US2**.
   - The FHR1 value shows three steady dashes "– – –."
   - The FHR2 value shows three steady dashes "– – –."
   - The recorder prints the messages *US* and *US2* on the center margin of the strip chart paper.

4. Use your finger to rub the face of the ultrasound transducer connected to the monitor's **US** input connector; try to maintain a steady rate and verify the following on the monitor:
   - The FHR1 value responds to the rubbing.
   - The FHR1 heartbeat indicator (♥) responds to the input.
   - The recorder prints the heart rate tracing corresponding to the rate and the trace is plain black (⌐⩘⩘).

5. Use your finger to rub the face of the ultrasound transducer connected to the monitor's **US2** input connector; try to maintain a steady rate and verify the following on the monitor:
   - The FHR2 value responds to the rubbing.
   - The FHR2 heartbeat indicator (♥) responds to the input.
   - The recorder prints the heart rate tracing corresponding to the rate and the trace is bold black (⌐⩘⩘).

Alarm Test

This portion of the test ensures the integrity of the audio alarms and tests the alarm limit software.

1. Connect the FECG/MECG adapter cable to the **FECG/MECG** input connector on the 250 Series Monitor.
2. Connect the Model 325 Simulator's ECG cable to the adapter's **MECG** input.
3. Use the Trim Knob control to access the *MHR/P Setup* screen.
4. Set the MHR/P source to *MECG*.
5. Set the MHR/P high alarm limit value to 120 bpm.
6. Set the MHR/P low alarm limit value to 60 bpm.
7. Set the alarm volume to a level you can easily hear.
8. Exit the *MHR/P Setup* screen.
9. Access the *Master Alarm Setup* screen.
10. Access *Install Options Screen 2*.
11. Select *Store Current to Hospital.* Exit the service mode by selecting *Restart* at the bottom of the screen.

12. Set the switches on the Model 325 Input Simulator according to Table 15.
13. Using the simulator's **Manual Adjustment** knob, input an MECG signal of 119 bpm as indicated on the monitor. Verify that there is no alarm tone sounding from the monitor's rear panel speaker.
14. Using the simulator's **Manual Adjustment** knob, increase the MECG rate to 120 bpm. Again, verify that there is no alarm tone sounding from the rear panel speaker.
15. Using the simulator's **Manual Adjustment** knob, increase the MECG rate to 121 bpm. Verify the following on the monitor:
    - The following alarm tone is emitted from the rear panel speaker: alternating high/low tones until the alarm condition is removed (following steps.)
    - The MECG value flashes.
16. Depress the monitor's front panel **Alarm Silence** button and verify the following:
    - The alarm tone is silenced.
    - The *ALARM SILENCE X:XX* message box appears on the screen and a countdown is started.

Table 15. Alarm Test Simulator Settings

Section	Switch	Setting
FECG/MECG	Main	Rate
	Rate	Manual
	Mode	MECG
	QRS Amplitude	500 µV
	QRS Polarity	+
GENERAL	Pattern Memory	Off

17. Wait the user-specified re-alarm time and verify the following:
    - The alarm tone is once again emitted from the rear panel speaker.
18. Use the simulator's **Manual Adjustment** knob to decrease the MECG rate to 120 bpm. Verify the following on the monitor:
    - The alarm tone is silenced.
    - The MECG value no longer flashes.
    - After 10 seconds, the two above conditions are still true.
19. Using the simulator's **Manual Adjustment** knob, input an MECG signal of 61 bpm. Verify that there is no alarm tone sounding from the rear panel speaker.
20. Using the simulator's **Manual Adjustment** knob, decrease the MECG rate to 60 bpm. Again, verify that there is no alarm tone sounding from the rear panel speaker.
21. Using the simulator's **Manual Adjustmen**t knob, decrease the MECG rate to 59 bpm. Verify the following on the monitor:
    - The alarm tone is emitted from the monitor's rear panel speaker.
    - The MECG value flashes.

22. Depress the monitor's front panel **Alarm Silence** button and verify the following:
    - The alarm tone is silenced.
    - The MECG value continues flashing.
    - The message *ALARM SILENCE X:XX* appears on the screen and a countdown is started.
23. Wait the user-specified re-alarm time and verify the following:
    - The alarm tone is once again emitted from the rear panel speaker.
24. Use the simulator's **Manual Adjustment** knob to decrease the MECG signal to 60 bpm. Verify the following on the monitor:
    - The alarm tone is silenced.
    - The MECG value no longer flashes.
    - After 10 seconds, the two above conditions are still true.

$MSpO_2$ Test

1. Access the 250 Monitor's *$MSpO_2$ Setup* window and configure as follows:
    - (Nellcor only) *Response Time = Fast*
    - (Masimo only) *Sensitivity = Normal*
    - (Masimo only) *Averaging = 8*
    - *Print Interval = 2 minutes*
    - *% O2 Trace = On*
2. Access the monitor's *Install Options Screen 1* and set the *SpO_2 Scale* to *Auto.* Select *Store Current to Hospital.* Exit the service mode by selecting *Restart* at the bottom of the screen.
3. Access the monitor's MHR/P Setup window and configure as follows:
    - MHR/P *Source = $MSpO_2$*
    - MHR/P *HR/PR Trace = On*
4. Connect an SpO_2 finger sensor.
5. Allow the monitor a few seconds to obtain a steady reading.
6. Turn on the recorder and allow data to collect for at least five minutes.Verify the following on the monitor:
    - The correct waveform appears on the display.
    - The $MSpO_2$ displays a value.
    - The $MSpO_2$ pulse amplitude indicator shows a fluctuating bar graph.
    - The MHR/P display mode is *Pulse*.
    - The MHR/P displays a value.
    - The MHR/P trend plots in the top grid with the above value.
    - The $MSpO_2$ scale grid marks stamp on the paper.

- The message *MSpO2%* stamps in the annotation line on the strip chart paper.
- A diamond ◊ (with $MSpO_2$ and MHR/P vital signs) stamps in the annotation area on the strip chart paper at 2-minute intervals.

NIBP Calibration and Testing

Purpose

This describes the information needed by a biomedical or service personnel to successfully verify or set calibration and perform field test procedures for the 250 Series NIBP.

Required Hardware

Air Volumes

Only one air volume is required. The proper volume for all calibration procedures is a Normal cuff wrapped around a 3-inch rigid cylinder.

External Manometer

A peak reading external manometer is recommended. The external manometer must be capable of reading to 350 mmHg (46.7 kPa).

Do not use a DNI CuffLink for calibration procedures on a 250 Series Monitor.

External Pump

Use a hand bulb for all indicated manual inflation activities. The external manometer must read pressure in the same scale (mmHg or kPa) as the monitor. Settings can be changed on the monitor *Pressure Units* to match the unit setting on the manometer.

System Setup

Wrap a Normal cuff around a 3-inch rigid cylinder. Connect a standard 12-foot NIBP hose between the Adult cuff and the monitor. For any procedure requiring hand inflation, connect a hand bulb between the Adult cuff and the NIBP hose.

General Calibration Sequence

Any calibration session consists of a sequence of individual calibration procedures. The procedures are Calibration Verification, Calibrate Transducers, Overpressure Detection, and System Leakage.

All NIBP calibration procedures are accessed from the *NIBP Calibration* screen. To access the NIBP Calibration screen:

1. Navigate to *Install Screen Options 1.*
2. Select *Tests.*
3. Select *NIBP Cal.*

The sequence of procedures for calibration of NIBP starts with Calibration Verification. If Calibration Verification shows the NIBP transducers to be out of calibration then calibration should be performed. Only after NIBP transducers have been shown to be in calibration should any other test be performed. Both Overpressure Detection and System Leakage should always be performed.

Calibration Verification

1. Select *Verify* from the *Mode:* option.
2. The monitor will inflate the cuff to approximately 200 mmHg.
3. If either PT1 or PT2 pressure, from the external manometer, are > = 2 mmHg (0.3 kPa) different from the monitor indicated pressure then perform Calibrate Transducers procedure.
4. To stop Calibration Verification select *Done,* which appears after the *Verify* softkey has been pressed.
5. The monitor will vent pressure to atmosphere and re-zero the transducers.

Calibrate Transducers

1. Select *Calibrate* from the *Mode:* option.
2. The monitor will inflate the cuff to approximately 200 mmHg (26.7 kPa).
3. Once the pressure has stabilized, enter the pressure from the external manometer in *External:*
4. Best accuracy is achieved if the system is given a short time to settle. Best accuracy is achieved if the system pressure is at or near 200 mmHg (26.7 kPa).
5. Additional pressure can be inserted into the system using a hand bulb.
6. The monitor will vent pressure to atmosphere and re-zero the transducers.
7. Perform a Calibration Verification and repeat Calibration if new calibration factors still show the transducers out of calibration
8. Commit the new calibration factors by selecting *Store Calibration.*

NOTE: Between entering the external pressure and committing the new calibration factors the *Exit* menu item will display as *Exit – No Store* to indicate current calibration factors will be lost if Service Mode is exited prior to selecting *Store Calibration.*

NOTE: The menu item *Store Calibration* will only display after Calibration Verification has been performed during the Calibration procedure.

Overpressure Detection

1. Select *OVP Test* from the *Mode:* option.
2. The monitor will close the valves.
3. Reset the peak read feature of the external manometer.
4. Using the hand bulb inflate system until overpressure is detected. When approaching the overpressure trip point inflate the system slowly.
5. If overpressure occurs outside of 300 mmHg (40.0 kPa) to 330 mmHg (44.0 kPa), on the external manometer, then:
6. Retest by slowly inflating monitor pressure.
7. Recheck Calibration Verification and retest Overpressure Detection.
8. Call Technical Support.
9. Upon detection of overpressure the monitor will vent pressure to atmosphere and re-zero the transducers.
10. The maximum monitor detected pressure will be displayed near the bottom of the *NIBP Calibration* screen.

System Leakage

1. Select *Leak Test* from *Mode:*.
   - Make sure you have the 12 foot hose and Normal Adult Cuff tightly wrapped around a rigid 3-inch cylinder. This air volume is required to properly test the units leakage rate.
2. Monitor will inflate to approximately 200 mmHg (26.7 kPa).
3. Following inflation the monitor will allow 45 seconds of settling time.
4. Following the settling period two pressure readings are taken 30 seconds apart, and used to calculate the system leakage rate.
5. The monitor vents pressure to atmosphere following the 30 second measurement period.
6. When complete the leakage rate (mmHg [or kPa]/min) will be displayed, with *PASS* or *FAIL*, near the bottom of the *NIBP Calibration* screen.
7. System leakage rate should be < = 6 mmHg (0.8 kPa)/minute.
   - If the monitor has a leakage rate > 6mmHg (0.8 kPa)/min., inspect the external and internal pneumatic hoses, valves, connectors for loose connection and or leaks.

Display Check

There is no calibration or replacement procedure for either the Display Driver Board or the Power Controller Unit. Contact your GE Service Representative for information about repair/exchange of the entire display assembly.

WARNING
HIGH VOLTAGE—The 250 Series Monitor display backlight generates potentially dangerous voltages capable of causing personal injury (~700 VAC). Do not touch the display electronics during operation!

CAUTION
ELECTROSTATIC DISCHARGE—The 250 Series Monitor display uses CMOS and MOS-FET components. These components are electrostatic sensitive. Unpack, assemble, and examine this assembly in a static-controlled area only. When shipping, use packing materials designed for protection of electrostatic-sensitive components.

Checking a Display

In troubleshooting, the following methods can be employed to determine whether a problem exists with the display assembly, the 250 Series Monitor DSP Board or the interconnect cable.

Verifying the DSP Board Operation

1. Turn off the monitor.
2. Remove the nine screws which secure the monitor top cover. Four screws are located on the bottom of the monitor and five screws are located in the back.
3. Remove the cover by sliding it toward the rear of the monitor.
4. Unplug the display interconnect cable from J2 on the DSP Board.
5. Turn on the 250 Series Monitor.
6. For making the following measurements on the DSP Board, use J2 (pin 1) on the for the ground (or negative) connection.
7. Using a digital voltmeter, measure the LCD voltage at J2 (pin 6). Verify that the LCD voltage is +3.3 Vdc $\pm$ 0.3 Vdc.
8. Using an oscilloscope, verify the presence of the periodic waveform signal VCLK at J2 (pin 3).
9. Using an oscilloscope, verify the presence of the periodic waveform signal HSYNC at J2 (pin 7).
10. Using an oscilloscope, verify the presence of the periodic waveform signal VSYNC at J2 (pin 11).
11. If you suspect that the DSP Board is not supplying the correct voltage or one of the video signals is missing and you have another properly functioning 250 Series Monitor, substitute the DSP Board and check for proper operation. Contact your GE Service Representative for information about repair/exchange of the DSP Board.

12. If you suspect that the interconnect cable is not working properly, refer to Chapter 6, "Parts List, Drawings, and Replacement" or contact your GE Service Representative for part ordering information.
13. If you suspect that either the Display Driver Board or the Controller Power Unit are not functioning correctly and you have another properly functioning 250 Series Monitor, substitute the entire display assembly and check for proper operation. Refer to "Checkout" and "Checkout". Contact your GE Service Representative for ordering information.

Maternal SpO_2 Calibration

The 250 Series Monitor automatically performs a self-test on the pulse oximetry module upon power up and whenever the $MSpO_2$ module is reset. The self-test verifies the integrity of the ROM, RAM, Back-End Processor, and System Voltage levels. The module operation begins if no error was detected during the self-test.

Hardware Switches

The 250 Series Monitor Main Motherboard contains one dip switch pack SW1, which is used to:

- enable/disable a factory test mode (for factory use only);
- select between Hewlett-Packard or Corometrics–compatible outputs from the rear panel **J102** connector;
- set the clock speed;
- enable/disable the maternal NIBP option;
- enable/disable/select the $MSpO_2$ option;
- enable/disable the MECG option.

To configure these switches:

1. Turn off the 250 Series Monitor and disconnect the power cord from the monitor.
2. Remove the nine screws which secure the monitor top cover. Four screws are located on the bottom of the monitor and five screws are located in the back.
3. Remove the cover by sliding it toward the rear of the monitor.
4. Set the switches according to the table below.
5. Replace the monitor top cover and secure with all nine screws.
6. Re-connect the power cord and turn on the monitor.

Table 16. Hardware Switch Settings		
Switch #	Description	Setting
1	Factory Test	Off = Enabled
2	J102 Output Levels	Off = HP, On = Coro
3	Reserved	Set to Off
4	NIBP Option	Off = Enabled
5	$MSpO_2$ Option	5:Off 6:Off = Nellcor 5:Off 6:On = Ohmeda
6	$MSpO_2$ Option	5:On 6:Off = Masimo 5:On 6:On = No $MSpO_2$
7	Inactive	Inactive
8	MECG Option	Off = Enabled

Main Board SW1 Switch Settings

This area of the display allows you to see the hardware switch settings (SW1) on the Main Motherboard—without removing the cover of the monitor. The switch settings are displayed from left (SW1-8) to right (SW1-1). Refer to Table 17.

To access the *Diagnostic Control* screen select the *Service* softkey at the bottom of the *General Setup* Screen. Input the *Service Lock* access code, then the *Install Options Screen 1* appears. Select the *Tests* softkey from the bottom of the screen, the *Diagnostic Control* screen appears.

Example 1:

1 0 1 0 1 1 1 0

MECG MSpO2 NIBP

J102 Analog Output Connector DAC Static Test

This screen displays the **J102** pin numbers, the signal descriptions, the range of allowable values for measured voltages, the expected output voltages, and the settings (meaning) adjustable using the Trim Knob control. Use this screen while verifying and calibrating the digital-to-analog converters (DACs) on the Communications Board (No. 13388 or 15297).

1. Access the *Diagnostic Control* screen by selecting the *Service* softkey at the bottom of the *General Setup* Screen. Input the *Service Lock* access code, then the *Install Options Screen 1* appears. Select the *Tests* softkey from the bottom of the screen. (Refer to"Diagnostic Control Screen" on page 5-5 for instructions.)

2. Use the Trim Knob control to select the *J102* softkey at the bottom of the screen. The *J102* screen displays. (See figure "J102 Analog Output Connector Screen" on page 4-50.)
3. The *Range* and *Voltage* fields can be displayed using a decimal point or a comma as a separator. Each activation of the *Decimal* softkey at the bottom of the screen alternates between using a decimal and a comma.
4. Use the Trim Knob control to cycle through the available settings for each field. The expected voltage for each **J102** pin number changes accordingly.

Verification

For each pin, select a value in the *Meaning* field and measure the expected output.

Analog Ground

This field is not adjustable. Use **J102**, pin 3 as a ground when making measurements on other pins.

HR1 and HR2

Use the Trim Knob control to select: – – – (0 bpm) or 30–240 bpm in increments of 1 bpm.

UA

Use the Trim Knob control to select from the full range of mmHg or kPa in increments: mmHg ranges from 0-100 in steps of 1; kPa ranges from 0-13.3 in steps of 0.1 or 0.2 (based on rounding from mmHg).

HR1 Mode

Use the Trim Knob control to select: *– – –, FECG, Off, US,* or *INOP.*

HR2 Mode

Use the Trim Knob control to select: *TEST, FECG, INOP, US,* or *MECG.*

UA Mode

Use the Trim Knob control to select: *– – –, INOP, Off, IUP, or TOCO.*

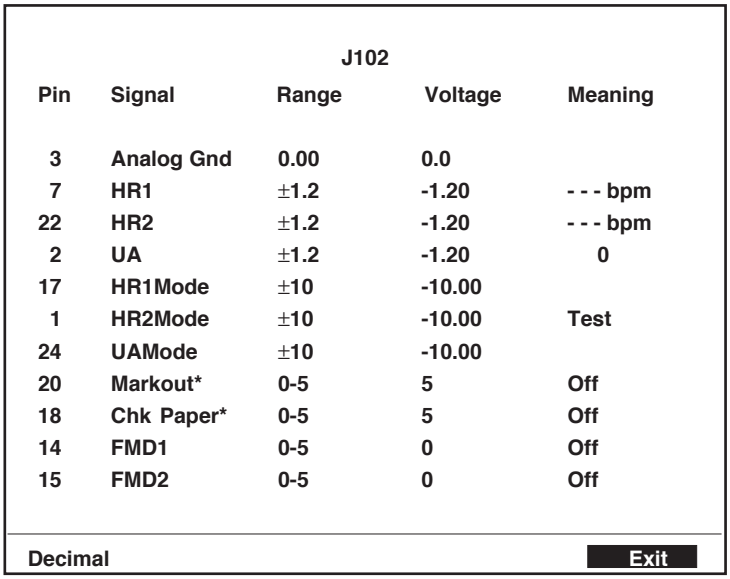
Markout*, Check Paper*, FMD1, and FMD2

Use the Trim Knob control to alternate between *On* and *Off*.

NOTE: Signal names followed by an asterisk (*) or slash (/) are active low.

Calibration

For calibration, you must use the specific values listed in Table 17 (Corometrics output levels) or Table 18 (Hewlett-Packard output levels). This tests the high and low ranges for the HR1, HR2, and UA signals. If a measured value does not fall within the given range, adjust the corresponding potentiometer accordingly (on Communications Board, No. 13388 or 15297).


J102
Pin Signal Range Voltage Meaning
3 Analog Gnd 0.00 0.0
7 HR1 ±1.2 -1.20 - - - bpm
22 HR2 ±1.2 -1.20 - - - bpm
2 UA ±1.2 -1.20 0
17 HR1Mode ±10 -10.00
1 HR2Mode ±10 -10.00 Test
24 UAMode ±10 -10.00
20 Markout* 0-5 5 Off
18 Chk Paper* 0-5 5 Off
14 FMD1 0-5 0 Off
15 FMD2 0-5 0 Off
Decimal
Exit

J102 Analog Output Connector Screen

Table 17. DAC Output Voltages and Adjustment Points for Corometrics Central Station Outputs

Analog Signal	Measurement Site	Service Screen Setting	Expected Voltage	Adjustment Site
HR1	J102, pin 7	– – –	–1.2 V ± 10 mV	R18
		240 bpm	+1.2 V ± 10 mV	R20
HR2	J102, pin 22	– – –	–1.2 V ± 10 mV	R27
		240 bpm	+1.2 V ± 10 mV	R29
UA	J102, pin 2	0 relative units (mmHg and kPa)	–1.2 V ± 10 mV	R42
		100 mmHg 13.3 kPa	+1.2 V ± 10 mV	R44

Table 18. DAC Output Voltages and Adjustment Points for Hewlett-Packard Central Station Outputs				
Analog Signal	**Measurement Site**	**Service Screen Setting**	**Expected Voltage**	**Adjustment Site**
HR1	J102, pin 7	240 bpm	+2.4V ± 10 mV	R20
HR2	J102, pin 22	240 bpm	+2.4 V ± 10 mV	R29
UA	J102, pin 2	100 mmHg 13.3 kPa	+10.0 V ± 24 mV	R44

RS-232C Connector Loopback Test

The Communications Setup screen includes a loopback test option for each of the communications ports: **J109, J110,** and **J111.** Running the test requires inserting a loopback test connector into each port being tested. (You can test more than one port at a time.)

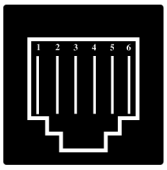
Making a Loopback Test Connector

Start with an RJ-11C connector and bridge pin 2 (RXD) and pin 5 (TXD) together. The figure below shows the pinout of a communications port while you face the rear panel of a 250 Series Monitor. Table 19 lists the signal description for each pin.

Testing the Port(s)

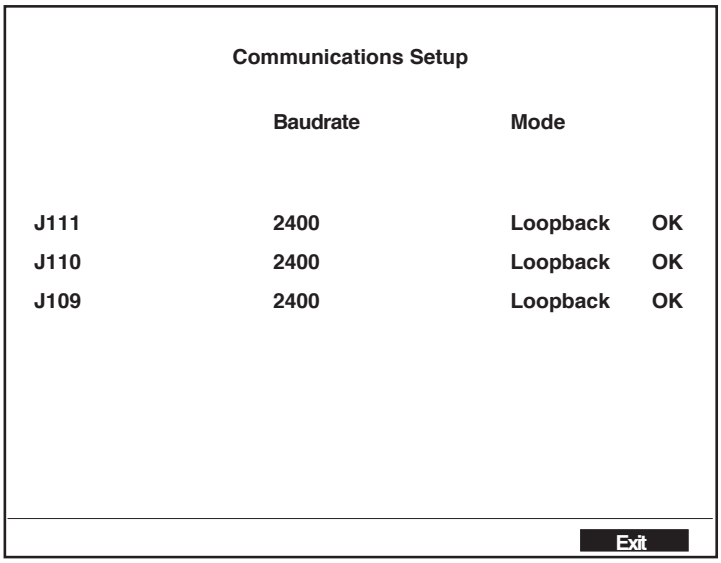
1. Access the *Communications Setup* screen (See "Communications Screen" on page 4-52).
2. Insert a loopback test connector into each communications port being tested.
3. Set the mode field on the *Communications Setup* screen to *Loopback*. Notice that the word *Off* displays to the right of the mode.
4. Verify that, after a few seconds, the status *Loopback OK* displays. *OK* indicates that the test has passed.

NOTE: If *Off* remains displayed, the test has failed; contact your GE Service Representative. Do not use this port to connect to any peripheral equipment until the port or Communications Board has been serviced.



RJ-11C Connector

Table 19. J109, J110, and J111 Communications Ports Connector Pinout	
J109, J110, Or J111 Pin #	**Signal Description**
1	RTS
2	RXD
3	GND
4	GND
5	TXD
6	CTS



Communications Screen

Calibration

This section of the manual provides a calibration procedure which allows authorized service personnel to perform an instrument alignment using a minimum of test equipment. This procedure is not intended to replace a complete instrument checkout and alignment as performed at the GE factory. It should be considered a performance check and troubleshooting guide to be used in conjunction with other information supplied throughout this service manual. It is important to mention, this section of the manual is not intended as a substitute for proper professional training, or familiarity with the monitor. Only qualified service personnel should attempt servicing the 250 Series Monitor.

Before You Begin Electronic Calibration

General

Refer to the assembly drawings for the location of adjustments and test points referred to in this section. The board assembly drawing numbers are given for each board in this section. The electronic calibration procedure outlined in this section necessitates removal of the monitor's top cover. Also, the following equipment will be needed in order to carry out the procedural steps.

- Digital Voltmeter, 4 1/2 digit or equivalent
- Plastic Alignment Tool
- Oscilloscope

Handling Precautions

The following guidelines should be followed when handling *circuit boards or assemblies containing circuit boards*. Following these procedures helps resist damage that can be caused by static electricity.

- Discharge any static charge you may have built up before handling parts.
- Wear a grounded, anti-static wristband at all times.
- Use a static-free work surface.
- Store items in anti-static bags or boxes.
- Do not remove items from anti-static containers until needed.

Power Supply Voltages—Verification

There are no adjustments for the power supply voltages; however, you can verify them as follows:

Main Board Power Supply Voltages

Using a digital voltmeter, measure and verify the power supply voltages using the **J14** connector on the Main Board. Refer to Table 20.

NOTE: There are no adjustments for these voltages.

Table 20. Main Board Power Supply Voltages		
2023111-001	**Signal Name**	**Voltage Level**
Pin 1	+12EL	+12 Vdc ± 0.5 Vdc
Pin 2	+20I	+20 Vdc ± 0.5 Vdc
Pin 3	+15BP	+15 Vdc ± 0.5 Vdc
Pin 4	–15V	–15 Vdc ± 0.5 Vdc
Pin 5	+15V	+15 Vdc ± 0.5 Vdc
Pin 6	+12A	+12 Vdc ± 0.5 Vdc
Pin 7	+5V	+5 Vdc ± 0.5 Vdc
Pin 8	GND	—
Pin 9	No Connection	—
Pin 10	Keying	—

Isolated Power Supply Board Voltages

Verify the following voltages, being sure to use the correct ground reference points.

Ground Reference	Test Point	Measurement Limit
TP8	TP7	16.5 ±.15 Vdc
TP8	TP17	15 ±.75 Vdc
TP8	TP16	-15 ±.75 Vdc
TP8	TP18	5 ±.25 Vdc
TP5	TP10	15 ±.75 Vdc
TP5	TP11	-15 ±.75 Vdc

Isolated FECG/UA Board Voltages

This procedure performs an adjustment on the FECG/UA Board.

- Connect the positive lead of a digital voltmeter to TP1 on the FECG/UA Board.
- Connect the negative lead to TP2 or TP3 (isolated ground).
- Adjust R28 for a reading of +4.00 Vdc ± 0.01 Vdc.

Recorder Photosensor Calibration

Adjusting the Paper-Low Photosensor

1. Load paper in the recorder. Ensure that there are *no* black squares showing to indicate a paper-low condition.
2. Press the **Record** button to turn on the recorder. Allow the paper to advance for a few seconds in order to tension the paper.
3. Turn off the recorder.
4. Using a digital voltmeter, connect the positive lead to J9 (pin 4) on the Recorder Board; connect the negative lead to J9 (pin 2).
5. Adjust R31 for a reading of +150 mVdc ± 2 mVdc on the digital voltmeter.

NOTE: If you open and then close the recorder door, the reading may vary 5–10 mV, due to the loss of tension in the paper. This is acceptable and you do not need to re-adjust.

6. Open the door and verify that the reading on the digital voltmeter is greater than +4.75 Vdc.
7. Re-load the paper so that black squares show on the surface (i.e., the last several sheets of a pack).
8. Turn on the recorder.
9. The value on the digital voltmeter should go up and down as the paper surface alternates between black and white. Verify that the maximum value is greater than or equal to 2.0 Vdc.
10. Turn off the recorder.

Adjusting the Paper-Out Photosensor

1. Load paper in the recorder. Ensure that there are *no* black squares showing to indicate a paper-low condition.
2. Press the **Record** button to turn on the recorder. Allow the paper to advance for a few seconds in order to tension the paper.
3. Turn off the recorder.
4. Using a digital voltmeter, connect the positive lead to J9 (pin 3) on the Recorder Board; connect the negative lead to J9 (pin 2).
5. Adjust R29 for a reading of +150 mVdc ± 2 mVdc on the digital voltmeter.

NOTE: If you open and then close the recorder door, the reading may vary 5–10 mV, due to the loss of tension in the paper. This is acceptable and you do not need to re-adjust.

6. Open the door and verify that the reading on the digital voltmeter is greater than +4.75 Vdc.
7. Turn off the recorder.

Adjusting the Paper-Loading Sensor

1. Load paper in the recorder. Ensure that there are *no* black squares showing to indicate a paper-low condition. You must load at least nine sheets of paper.
2. Using a digital voltmeter, connect the positive lead to J9 (pin 6) on the Recorder Board; connect the negative lead to J9 (pin 2).
3. Adjust R41 for a reading of +190 mVdc ± 5 mVdc on the digital voltmeter.
4. Although a factory-only fixture is required for this step, you may wish to try it by estimating the required distance. Load paper *backwards* with the white surface 0.380 in away from the paper tray. This creates a paper-loading error condition. Verify that the voltage at J9 (pin 6) on the Recorder Board is at least 2.70 Vdc.

Repair Log

Unit Serial Number **Institution Name**			
Date	**Maintenance/ Repair**	**Technician**	**Date**

Preventative Maintenance Inspection Report

Customer_____ Customer Number_____ Date _____

FE_____ FE ID _____Call Number _____

Equipment Serial Number _____ Software Revision CPU _____ DSP: _____

Configuration

Model 256_____ Model 259 _____ Fetal Movement Detection (FMD) _____

Tools Required

• Digital Multimeter	• Static-Free Work Surface
• Plastic Alignment Tool	• Mild Soap/Water Solution
• Standard Hand Tools	• Isopropyl Alcohol
• Leakage Current Tester	• Baum Manometer
• Leg Plate (1590AAO with 1442AAO adapter cable)	• FECG/MECG Adapter (1442AAO)
• Model 325 Simulator with Cables	• Baum Test Connector
• ESD Mat and Wristband	• 250 Operator's Manual (2020550-001)
	• Assembly Leakage Cable

Visual Inspection

Inspect the following for excess wear and/or signs of damage. (Refer to "Visual Inspection" on page 4-4)

☐ AC Power Cord	☐ $MSpO_2$ Cable/Sensor
☐ Ultrasound Transducer	☐ Connectors
☐ MECG Patient Cable	☐ Interconnect Cables
☐ Leg Plate	☐ Chassis
☐ Tocotransducer	☐ 2116 Keyboard (if used)
☐ IUPC Transducer	☐ Front Panel Switches
☐ IUPC Intermediate Cable	☐ Internal Harnesses/Connectors
☐ Remote Marker	☐ Power Supply Fan
☐ NIBP Hose/Cuff	☐ FECG, MECG "Y" Adapter Cable (1442AAO)

Page	Description	Complete	Max	Actual	Pass	Fail	N/A
Cleaning							
4-5	Clean the monitor exterior.						
	Clean the monitor interior using a hand-held vacuum.						
4-8	Clean the recorder printhead.						
4-8	Clean the UA Strain Gauge.						
4-6	Clean the monitor accessories (TOCO, transducers, cables)						
4-5	Clean the monitor accessories (cuffs, hoses)						
Calibration							
Page	**Description**	**Complete**	**Max**	**Actual**	**Pass**	**Fail**	**N/A**
4-53	Verify the power supply voltages on the Main Board.						
4-54	Verify the power supply voltages on the Isolated Power Supply Board.						
5-9	Adjust the printhead.						
4-55	Adjust the photosensors on the Recorder Board.						
Electrical Safety Tests							
Page	**Description**	**Complete**	**Max**	**Actual**	**Pass**	**Fail**	**N/A**
4-10	AC Line (120 V ↑ 10%)		(<300 mW)				
4-10	Ground Impedance (<300 MΩ) Lead to rear panel ground lug (<300 MΩ) Lead to top cover bezel screw (<300 MΩ)		(<300 mW)				
4-10	Unit to primary leakage		(<300mA)				
4-11	Patient-to-Ground leakage for ECG		(<50mA)				
4-12	Patient-to-Line leakage for ECG		(<50mA)				
4-12	Patient-to-Ground leakage for IUP		(<50mA)				
4-13	Patient-to-line leakage for IUP		(<50mA)				
4-13	Patient-to-Ground leakage for $MSpO_2$		(<50mA)				
4-14	Patient-to-Line leakage for $MSpO_2$		(<50mA)				
4-14	Patient-to-Ground leakage for US		(<50mA)				

Page	Description	Complete	Max	Actual	Pass	Fail	N/A
4-15	Patient-to-Line leakage for US		(<50mA)				
4-15	Patient-to-Ground leakage for US2		(<50mA)				
4-15	Patient-to-Line leakage for US2		(<50mA)				
4-16	Ground Continuity						
Functional Checkout Tests							
Page	**Description**	**Complete**	**Max**	**Actual**	**Pass**	**Fail**	**N/A**
5-3	Monitor Self-Test						
4-22	Front Panel Button Test						
4-23	MECG Test						
4-26	FECG Test						
	Leg Plate Test (Follow Manufacturer's Directions)						
4-29	Ultrasound Test						
4-31	Fetal Movement Detection Test						
4-32	Ultrasound Test						
4-33	Uterine Activity Test						
4-35	Tocotransducer Test						
4-36	Strain Gauge Test (if used)						
4-37	Pattern Memory Test						
4-38	Dual Heart Rate Test						
4-49	Dual Ultra Sound Modes						
4-40	Alarm Test						
4-42	$MSpO_2$ Test						
4-43	Pneumatic Pressure Check (annual)						
5-6	Recorder Calibration Test						

Comments:

5 Troubleshooting

For your notes

Diagnostic Tests

Main Motherboard and DSP Board Self-Test

Upon power-up, the 250 Series Monitor's Main Motherboard and DSP Board perform a number of tests before allowing the monitor to enter the normal operational mode. After setting the **Power** switch to the on (I) position, the tests run for approximately 2 seconds. If all tests pass, the monitor enters the normal operational mode. During normal operational mode, the monitor continues to perform a series of self-tests. If a test fails, you will see one of the following error messages centered in the display:

SYSTEM FAULT: ROM

SYSTEM FAULT: RAM

SYSTEM FAULT: Alert

SYSTEM FAULT: UI KEYPAD

SYSTEM FAULT: SOFTWARE

SYSTEM FAULT: DEFAULTS

SYSTEM FAULT: DSP

The first errors indicate problems on the Main Motherboard. The last error indicates a problem on the DSP Board. If the monitor displays any of these messages, turn off the monitor and contact your GE Service Representative.

Monitor Self-Test

The 250 Series Monitor contains self-test routines which verify the unit's calibration and internal circuitry. These routines are initiated by depressing the front panel **Test** button. The test results are printed on the strip chart recorder paper, verifying the integrity of the unit.

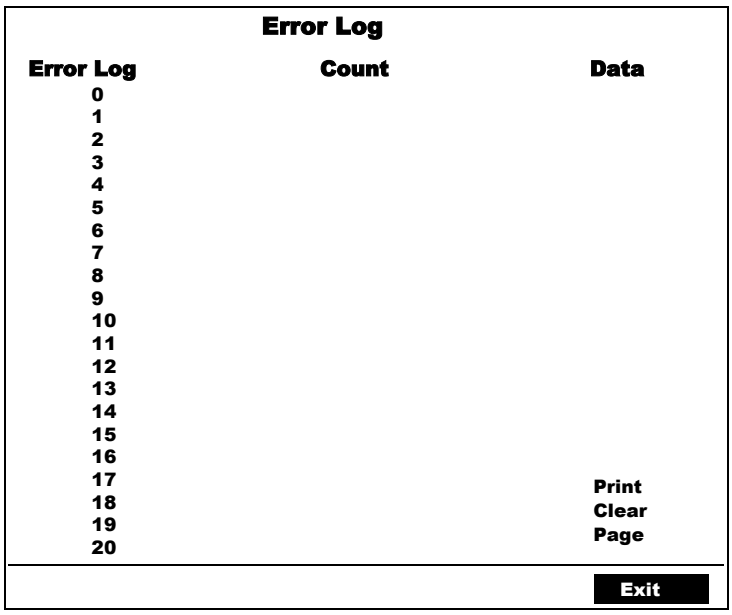
It is recommended practice to initiate the self-test feature at the beginning of each monitoring session. Refer to Self-Test Routine in the "Maintenance Section."

Error Log Screen

The *Error Log* screen, as shown below, displays a service log of the 250 Series Monitor. The service log is helpful to service representatives when diagnosing intermittent problems. There are 255 error codes that can be detected by the monitor. The *Error Log* is comprised of multiple pages with up to 20 error codes per screen. Each screen displays three columns:

- The *Error ID* column lists the error code. The *Count* column lists the number times the error code has occurred.

- The *Data* column lists other information associated with the error code. This column is for factory use only.



Error Log Screen

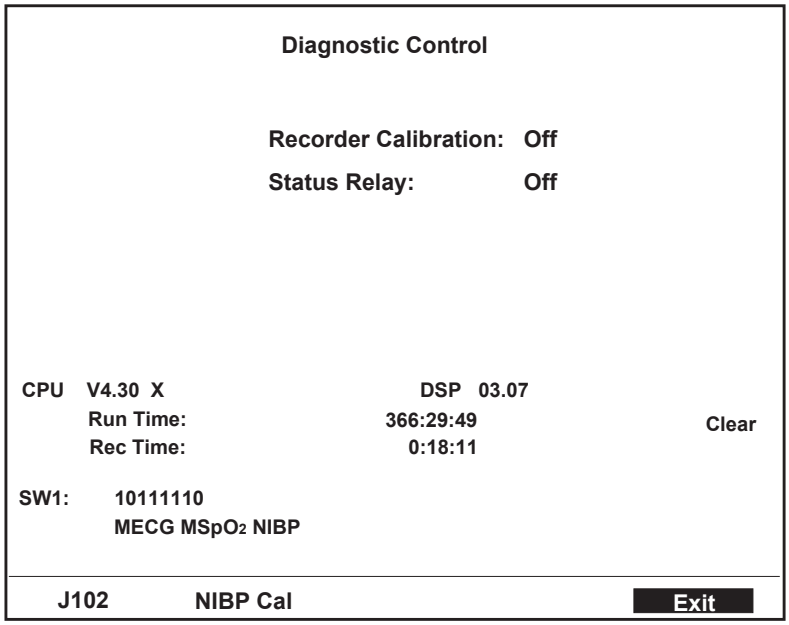
To use the *Error Log* screen:

1. Select the *Service* softkey from the *General Setup* screen.
2. The *Service Lock* screen appears.
3. Enter the correct access code; the *Install Options Screen 1* displays.
   a. Select *NextPage*.
   b. The *Install Options Screen 2* displays.
4. Select the *Log* softkey from the *Install Options Screen 2*.
5. The first *Event Log* screen displays.
6. Use the *Page* softkey to display the next screen (page), if applicable. The last page wraps back to the first page.
7. Use the *Print* softkey to print the displayed screen (page) on the strip chart recorder.
8. Use the *Clear* softkey to clear all the error log from the battery-backed RAM.

Diagnostic Control Screen

The *Diagnostic Control* screen, as shown below, is used to perform the following diagnostic self-tests:

- *Recorder Calibration* test;
- *Status Relay* softkey tests Nurse Call Interface relay;
- *CPU* software version number;
- *DSP* software version number;
- Monitor *Run Time*;
- Recorder run time *(Rec Time)*;
- *Clear* softkey sets run time and record to 0:00
- Main Board *SW1* switch setting summary;
- Softkey to access *J102* test screen; and
- Softkey to access the *NIBP Calibration* screen.

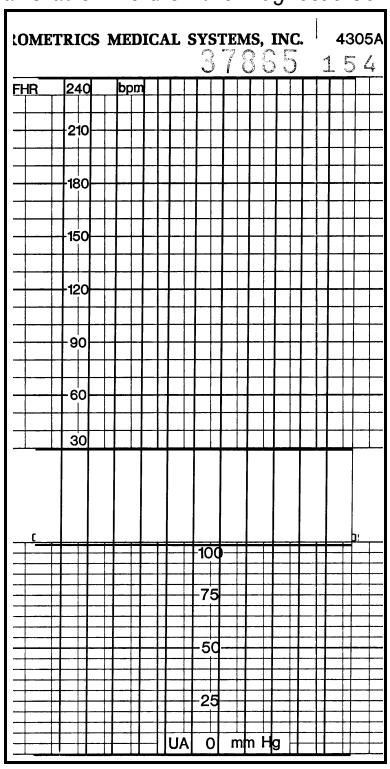


Diagnostic Control

Recorder Calibration Test

This test provides a method of testing the recorder calibration alignments.

1. Use the Trim Knob control to set the recorder calibration field on the *Diagnostic Control* service mode screen to *On*. The recorder prints four continuous horizontal lines at 0 mmHg, 30 bpm, and 240 bpm and the minimum and maximum rates on the HR scale (30 bpm and 240 bpm for domestic paper, 50 bpm and 210 bpm for international paper). The recorder prints a vertical line spanning across both grids every 3/16 inch. Refer to figure below.
2. Use this test while performing the adjustments in "Recorder Servicing" on page 5-7. The test will continue to print the lines until you cycle power on the monitor or set the calibration field on the *Diagnostic Control* screen back to *Off*.



Recorder Calibration Test

CPU Version

This field displays the software version number of the main processor installed on the Main Board in your monitor.

DSP Version

This field displays the software version number of the processor installed on the DSP Board in your monitor.

Run Time

This field displays the amount of time the monitor has been turned on—since the field was cleared. The time is displayed in hours, minutes, and seconds. To clear this field (reset the timer), activate the *Clear* softkey to the right of the run time field.

NOTE: The *Clear* softkey also resets the recorder time field.

Recorder Time

This field displays the amount of time the recorder has been turned on (or printing in maternal-only mode)—since the field was cleared. The time is displayed in hours, minutes, and seconds. To clear this field (reset the timer), activate the *Clear* softkey to the right of the recorder time field.

NOTE: The *Clear* softkey also resets the monitor run time field.

Recorder Servicing

Removing the Strip Chart Recorder

Removing the strip chart recorder requires *loosening* the monitor's front panel bezel. Following this procedure carefully will avoid unnecessary damage to bezel's mounting screws and the unit's front panel connectors.

1. Turn off the 250 Series Monitor and disconnect the power cord from the monitor.
2. Remove the nine screws which secure the monitor top cover. Four screws are located on the bottom of the monitor and five screws are located in the back.
3. Remove the cover by sliding it toward the rear of the monitor.
4. Remove the four screws that attach the recorder bracket to the bottom of the chassis.
5. Remove the two screws which fasten the right and left sides of the bezel away to the chassis.
6. Disconnect the display ribbon cable from the DSP Board at J5.
7. Disconnect the ribbon cable from the DSP Board.
8. Disconnect the ribbon cable from the Recorder Board at J2. Leave the other end connected to the Main Motherboard.
9. Disconnect the Power Supply cable harness from the Recorder Board at J1.
10. Lift the recorder and its attached bracket out of the monitor.

Installing the Strip Chart Recorder

1. Carefully place the recorder into the monitor housing and reassemble to the chassis bottom with four screws.
2. Re-connect the Power Supply cable harness to the Recorder Board at J1.

3. Re-connect the Main Motherboard ribbon cable to the Recorder Board at J2.
4. Re-connect the DSP ribbon cable to the membrane switch panel.
5. Re-connect the display ribbon cable to the DSP Board at J5.
6. Carefully reposition the front bezel. Secure all four screws.
7. Install the two screws which secure the recorder to the bottom panel.
8. Replace the copper grounding strips at the top of the front bezel. Be careful not to damage any of the fingers.
9. Replace the monitor top cover and secure with all nine screws.

Periodic Thermal Printhead Cleaning

Refer to "Periodic Thermal Printhead Cleaning" on page 4-8

Field Serviceable Assemblies

Disassembly and/or replacement of most recorder parts normally requires the use of special gauges and fixtures to ensure critical tolerances are satisfied; this includes drive roller assemblies. Therefore, field replacement is not recommended and field servicing is limited to the following recorder subassemblies:

- Stepper Motor and Harness
- Printhead
- Paper-Low Photosensor
- Paper-Out Photosensor
- Paper-Loading Photosensor

CAUTION
PRINTHEAD FAILURE—If a sudden or complete failure of the printhead occurs, the exact cause must be diagnosed accurately and corrected prior to installation of a new printhead.

Servicing of any recorder parts, other than the five subassemblies outlined above, should be referred to the nearest GE Service Representative.

Stepper Motor and Harness

Prior to removing/replacing the stepper motor, follow all instructions in the section, "Removing the Strip Chart Recorder" on page 5-7.

Removing the Stepper Motor

1. Disconnect the stepper motor harness cable from the Recorder Board at J4.
2. Loosen the two screws attaching the motor to the frame.
3. Slide the stepper motor sideways to the right and lift out.

Replacing the Stepper Motor

1. Slide new stepper motor into place.
2. Replace the two screws which attach the motor to the frame.
3. Re-connect the stepper motor harness cable to the Recorder Board at J4.

Printhead Adjustments

Refer to "Recorder Top View" on page 5-12 and "Recorder Right Side View" on page 5-12 for identification of the adjustment points outlined in this section, and to assist in clarifying adjustment procedures. These figures show top and right side views of the 250 Series Monitor strip chart recorder assembly removed from the unit's chassis.

Table 21 gives a description of each recorder adjustment. Adjustments C through F can be performed without removing recorder from unit's chassis; however, they require removing the monitor's top cover.

The printhead may require performing one or both of the following offset adjustment procedures.

Vertical Offset Adjustment

To check vertical offset alignment, run at least two monitor self-tests by depressing the front panel **Test** button. The first horizontal trace should be printed 0.490 ± 0.002 inch from the right hand paper guide. (Refer to figure "Vertical Offset Adjustment Self-Test Trace" on page 5-13.) Perform the following steps if the trace does not fall within the specified offset range.

1. Loosen the two set screws labeled **A** in Figure on page 5-12.
2. Adjust hex-head screw labeled **C** in Figure on page 5-12, until test trace falls within specified tolerance.
3. Tighten the two set screws labeled **A**.

Horizontal Offset Adjustment

Adjust the horizontal offset if any of the following symptoms are detected. If skewing occurs, check for other malfunctions. Noticeable skewing of a vertical line printed on the strip chart paper is usually accompanied by one of the following symptoms:

- Paper consistently curls to one side.
- Printing of unequal weight occurs along the vertical trace line, from one end to the other.
- Dots are missing along the vertical trace.
- Printing is too light following printhead replacement.

If the Horizontal Offset Adjustment is required, perform the following steps:

1. Loosen the four hex-head lock screws—two on each side. The right side screws are labeled **B** in the figure on page 5-12.
2. To move the printhead forward on one side, back-off the corresponding captive screw (turn counterclockwise) from its alignment block. To move the printhead backward on one side, tighten the corresponding captive screw (turn clockwise).
3. After making the necessary adjustments, tighten the four hex-head lock screws labeled **B**.

Table 21. Printhead Adjustments

Adjustment	Description
A	Set screws loosened to perform a vertical offset adjustment.
B	Hex-head screw loosened to perform a horizontal offset adjustment.
C	Hex-head screw which determines the vertical offset of a horizontal line. (See Figure on page 5-13.)
D	Captive hex-head screw which controls the horizontal offset of a vertical line on the top grid of the strip chart paper (heart rate channel).
E	Captive hex-head screw which controls the horizontal offset of a vertical line on the bottom grid of the strip chart paper (uterine pressure channel).

Thermal Printhead

The thermal printhead is a part of the printhead assembly. Refer to the parts list in Chapter 6, "Parts List, Drawings, and Replacement" , of this manual for ordering information.

Removing the Printhead

Use the following procedure for removing the 250 Series Monitor printhead. As long as you have a short screwdriver, you will not need to remove the strip chart recorder from the monitor.

1. Turn off the 250 Series Monitor and disconnect the power cord from the monitor.
2. Remove the nine screws which secure the monitor top cover. Four screws are located on the bottom of the monitor and five screws are located in the back.
3. Remove the cover by sliding it toward the rear of the monitor.
4. Disconnect the printhead harness cable from J3 on the Recorder Board.

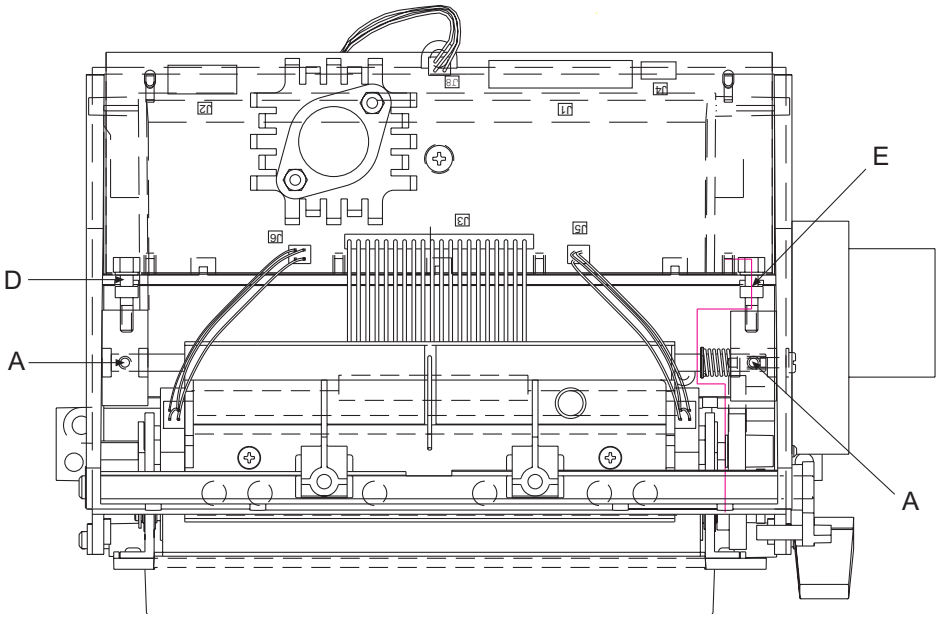
5. Open the recorder door.
6. Support the printhead by reaching in through the recorder door, then remove the two screws on top of the printhead.
7. Pull the printhead down and out through the recorder door with the harness still attached.

   NOTE If you are familiar with other Corometrics monitors, be assured that the four pressure springs are held captive and will not fall out.
8. Remove the harness cable from the printhead and retain for use with replacement printhead.

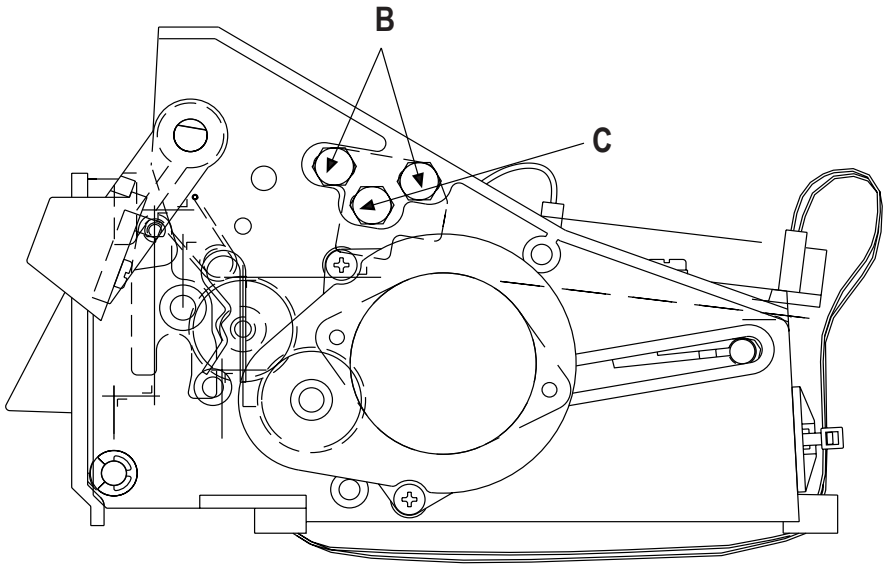
Replacing the Printhead

Use the following procedure for installing a 250 Series Monitor printhead:

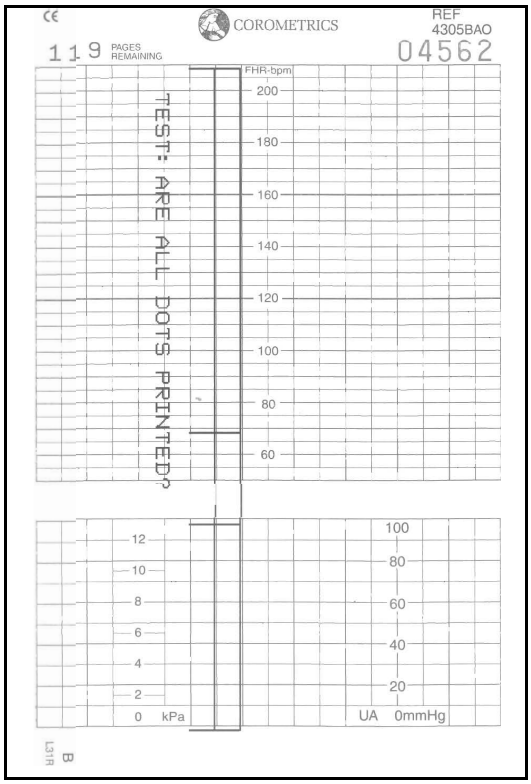
1. Turn off the 250 Series Monitor and disconnect the power cord from the monitor.
2. Carefully remove the new printhead from the packaging; do not touch any of the contact pins. Record the voltage rating marked on the decal affixed to the bottom of the printhead. This value is the VHEAD voltage. The voltage rating should be marked over the old voltage rating on the printhead bracket.
3. Re-connect the harness cable to the printhead.
4. Slide the new printhead into position through the recorder door and under its bracket. Push on the center of the printhead to ensure it is pushed all the way back.
5. Align the printhead with the front holes in the bracket and replace the two screws.
6. Re-connect the harness cable to the Recorder Board at J3.
7. Connect the positive lead of a voltmeter to TP1 on the Recorder Board; connect the negative lead to TP2.
8. Re-connect the monitor power cord and then turn on the monitor.
9. Press the **Record** button to turn on the recorder.
10. Adjust R2 on the Recorder Board until the reading on the digital voltmeter is within ±100 mV of the VHEAD voltage stamped on the printhead.
11. Access the Diagnostic Control service mode screen and run the recorder test to check the printing of vertical lines. (Refer to "Diagnostic Tests" on page 5-3.) If light printing occurs, refer to the instructions under "Horizontal Offset Adjustment" on page 5-9.
12. Replace the top cover and secure all nine screws.



Recorder Top View



Recorder Right Side View



Vertical Offset Adjustment Self-Test Trace

Paper-Low/Paper-Out Photosensor

Although these two reflective-sensors may be replaced in the field, tight tolerance repositioning is required to ensure that the sensors function properly. Therefore, it is recommended that the photosensors be replaced by a GE Service Representative. If the replacement is done locally, it must be done according to the following procedure.

NOTE: When facing the front of the monitor: the paper-low sensor is on the right side; the paper-out sensor is on the left side.

Removing the Paper-Low/Paper-Out Photosensor

Use the following procedure for removing the paper-low or paper-out photosensor.

1. Turn off the 250 Series Monitor and disconnect the power cord from the monitor.
2. Remove the nine screws which secure the monitor top cover. Four screws are located on the bottom of the monitor and five are located in the back.
3. Remove the cover by sliding it toward the rear of the monitor.
4. Disconnect the respective sensor cable from the black sensor housing. Record the orientation of the connector for replacement later.

5. Using an allen wrench, remove the two socket-head screws which attach the black sensor housing to the angle bracket.
6. Discard the sensor and housing.

Replacing the Paper-Low/Paper-Out Photosensor

Use the following procedure for replacing the paper-low or paper-out photosensor:

1. Attach the sensor and housing to the printhead support bracket using the two socket-head screws. Ensure that the black sensor housing is parallel with the top of the printhead bracket before tightening the screws.
2. Re-connect the sensor cable using the correct orientation.
3. Adjust the respective sensor as described next in this section.
4. Replace the monitor top cover and secure with all nine screws.

Adjusting the Paper-Low Photosensor

Refer to "Recorder Photosensor Calibration" on page 4-55 for detailed instructions.

Adjusting the Paper-Out Photosensor

Refer to "Recorder Photosensor Calibration" on page 4-55 for detailed instructions.

Paper-Loading Sensor

Follow the instructions for "Recorder Servicing" on page 5-7 before following this procedure:

Removing the Paper-Loading Photosensor

1. Disconnect the paper-loading sensor cable from J8 on the Recorder Board.
2. Turn over the recorder and place face down.
3. Cut and remove the cable tie which holds the sensor cable.
4. Remove the two screws which hold the sensor and housing to the paper tray.
5. Discard the sensor and printed circuit board.

Replacing the Paper-Loading Sensor

1. Use the following procedure for replacing the paper-loading photosensor:
2. Secure the sensor and printed circuit board to the paper tray and tighten both screws.
3. Connect the sensor cable to J8 on the Recorder Board.
4. Install a new cable tie to hold the cable in place.

NOTE: Ensure that there is enough slack in the cable so that when the recorder door is opened the cable does not become taut.

Re-install the strip chart recorder. Refer to "Installing the Strip Chart Recorder" on page 5-7. Do not replace the monitor top cover yet.

5. Adjust the paper-loading sensor as described next in this section.

Adjusting the Paper-Loading Sensor

Refer to "Recorder Photosensor Calibration" on page 4-55 for detailed instructions.

FAQs

Question	Answer
NOTE: When the monitor is powered off, then on again, the settings revert back to the factory default settings or can be saved if you choose *Store Current to Hospital* in the password-protected *Install Options Screen 2*. **To save your changes and exit the service mode:** 1. Go to the *Install Options Screen 2*. 2. If you are finished making changes, scroll down to *Store Current to Hospital,* and press the Trim Knob to confirm your selection. 3. Choose *Restart* on the bottom menu. The monitor power cycles off then on, saving your changes. **To revert back to the factory default settings and exit the service mode:** 1. Go to the *Install Options Screen 2*. 2. Scroll down to the *Default Settings:* softkey and turn the Trim Knob to *Factory*. Press the Trim Knob to confirm your selection. 3. Choose *Restart* on the bottom menu. The monitor power cycles off then on, reverting to the factory default settings.	
How are the 250 configurations settings stored and recalled?	1. Before you begin, it is important to understand the mechanisms by which the 250 Series Monitor retains configuration changes. The 250 Series Monitor "remembers" two configuration sets. These configuration sets may be set and configured from the password-protected *Install Options Screen 1* and *2* of the 250 Series Monitor, and include user settings present during normal operation. 2. Rotate the Trim Knob to highlight the *Setup* softkey at the bottom of the screen. 3. Once *Setup* is highlighted press the Trim Knob. 4. In the *General Setup* screen, rotate the Trim Knob to move the highlight to the *Service* softkey at the bottom of the screen. Press the Trim Knob. 5. The *Service Lock* screen appears. In the center of the screen are four single-digit fields below the field, *Enter Access Code.* These fields are used to enter the code to access restricted service settings in the 250 Series Monitors. The access code is the current date setting in the form of 'M M D D' or 'D D M M', where M M is the current month (01 to 12), and D D is the current date (01 through 31), however your monitor is configured. **NOTE:** The access code should reflect the *monitor's* date setting. If the monitor date is not correctly set, the access code for the actual calendar date will not work. 6. Rotate the Trim Knob to highlight each of the access code fields; press the Trim Knob, and rotate the Trim Knob to input the individual numbers that form the access code. When the last digit is entered and the Trim Knob pressed, the monitor then tests the access code. If valid, the screen changes to *Install Options Screen 1.* If invalid, the Trim Knob press does nothing. 7. Scroll to the bottom of *Install Options Screen 1* to the *NextPage* softkey at the bottom of the screen and press the Trim Knob. The *Install Options Screen 2* now appears. Scroll down to the *Default Settings:* softkey and turn the Trim Knob to toggle between the two choices: *Factory* or *Hospital*. 8. Choose *Factory* if you wish to use the default settings that are present when the monitor leaves the factory, and they apply in many, if not most, clinical environments. After selecting *Factory,* there is no need to select *Store Current to Hospital;* the changes are saved immediately. (Refer to the "Factory Defaults" on page 3-23 for definitions of the these defaults.) **NOTE:** *Factory* defaults may NOT be altered; it is configured for your country requirements. 9. Choose *Store Current to Hospital* if you wish to save the changes you made to the setup screens and the Install Options screens. 10. To exit the Service mode, follow the instructions at the top of Page 16. **NOTE:** The NIBP mode always reverts to manual mode upon power on.

Question	Answer
How do I change the alarm limits for Fetal Heart Rate 1?	1. Rotate the Trim Knob to highlight the field for FHR1. (This field is at the top left on the display, and it may read *INOP*, *FECG*, *US*, or *US2*. 2. Once you highlight the FHR1 field, press the Trim Knob. The display changes to show the applicable <MODE> *Setup* screen, where mode is the current field. 3. Now rotate the Trim Knob to highlight the FHR1 *High* heart rate alarm limit setting. 4. Once the *High* heart rate alarms limit is highlighted, press the Trim Knob again. The current setting in displayed in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value between *140 bpm* and *200 bpm* or *Off*. 6. Once you set the desired alarm value, press the Trim Knob again to confirm your selection. The current value setting stops blinking. 7. Repeat Steps 3 through 6 for the *Low* heart rate alarm setting. The valid range is *60 bpm* to *140 bpm* or *Off*. **NOTE:** The software does not permit the alarm settings to overlap. 8. To exit the Service mode, follow the instructions at the top of Page 16.
How do I change the alarm limits for Fetal Heart Rate 2?	1. Rotate the Trim Knob to highlight the field for FHR2. (This field is at the top left on the display, and it may read *INOP* or *US2*. 2. Once you highlight the FHR2 field, press the Trim Knob. The display changes to show the applicable <MODE> *Setup* screen, where mode is the current field. 3. Now rotate the Trim Knob to highlight the FHR2 *High* heart rate alarm limit setting. 4. Once the *High* heart rate alarms limit is highlighted, press the Trim Knob again. The current setting is displayed in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value between *140 bpm* and *200 bpm* or *Off*. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Repeat Steps 3 through 6 for the *Low* heart rate alarm setting. The valid range is *60 bpm* to *140 bpm* or *Off*. **NOTE:** The software does not permit the alarm settings to overlap. 8. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I change the alarm limits for Non-Invasive Blood Pressure?	1. Rotate the Trim Knob to highlight the field for *NIBP*. (This field is slightly above center, on the left side of the display. 2. Once the *NIBP* field is highlighted, press the Trim Knob. The display changes to show the *NIBP Setup* screen. 3. Rotate the Trim Knob to highlight the *Systolic High* alarm limit setting. 4. Once the *Systolic High* alarms limit setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value between *70 mmHg* and *240 mmHg (9.3 kPa and 32.0 kPa)*. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Repeat 3 through 6 for the ■*Systolic Low:* select a value between *50 mmHg* and *150 mmHg (6.7 kPa and 20.0 kPa)*. ■*Diastolic High:* select a value between *70 mmHg* and *130 mmHg (9.3 kPa and 32.0 kPa*). ■*Diastolic Low:* select a value between *30 mmHg* and *120 mmHg (4.0 kPa and 16.0 kPa)*. ■*MAP* (Mean Arterial Pressure) *High*: select a value between *70 mmHg* and *150 mmHg (9.3 kPa and 20.0 kPa)*. ■*MAP Low:* select a value between *30 mmHg* and *120 mmHg (4.0 kPa and 16.0 kPa)*. ■You may optionally change the MHR/P (Maternal Heart Rate/Pulse) *High*: select a value between *100 bpm and 250 bpm*. **NOTE:** The MHR/P alarm settings are also available through the *Pulse* softkey or the *MSpO$_2$* softkey on the main monitoring screen. ■You may optionally change the MHR/P *Low*: select a value between *35 bpm and 120 bpm*. **NOTE:** The MHR/P alarm settings are also available via the *Pulse* softkey, or the *MSpO$_2$* softkey, on the main monitoring screen. 8. To exit the Service mode, follow the instructions at the top of Page 16.
How do I change the alarm limits for MHR/P, Maternal Heart Rate Pulse?	1. Rotate the Trim Knob to highlight the field for *MHR/P*. (This field is located approximately in the center of the display and may indicate *MECG, Pulse* or *INOP,* depending on the settings that are currently enabled.) 2. Once the *MHR/P* field is highlighted, press the Trim Knob. The display changes to the *MHR/P Setup* screen. 3. Now rotate the Trim Knob to highlight the MHR *High* alarm limit setting. 4. Once the MHR *High* alarm limit setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value between *100 bpm and 250 bpm*. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting tops blinking. 7. Repeat Steps 3 through 6 for the MHR *Low* alarm limit setting. Select a value between *35 bpm and 120 bpm*. 8. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I enable the MHR/P, Maternal Heart Rate Pulse, trend recorder tracing?	1. Rotate the Trim Knob to highlight the field for *MHR/P*. (This field is located approximately in the center of the display, and may indicate *MECG, Pulse* or *INOP*, according on the settings that are currently enabled. 2. Once the *MHR/P* field is highlighted, press the Trim Knob. The display changes to show the *MHR/P Setup* screen. 3. Now rotate the Trim Knob to highlight the *HR/PR*: setting. (It should read *Off*.) 4. Once the *HR/PR*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a setting of *On* (to enable MHR/P trace) or *Off*. 6. Once you set the desired trace setting, press the Trim Knob to confirm your selection. The current setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.
How do I change the source parameter for MHR/P, Maternal Heart Rate Pulse?	1. Rotate the Trim Knob to highlight the field for *MHR/P.* This field is located approximately in the center of the display, and may indicate MECG, *Pulse* or *INOP* according to the settings that are currently enabled. 2. Once the *MHR/P* field is highlighted, press the Trim Knob. The display changes to show the *MHR/P Setup* screen. 3. Now rotate the Trim Knob to highlight the *Source*: setting. (It will read *Auto, $MSpO_2$, MECG*.) 4. Once the *Source*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select from *Auto, $MSpO_2$, MECG*. If you select *Auto*, the pulse value parameter is automatically selected according to the parameters that are currently enabled with precedence, highest to lowest, in the following order: *MECG, $MSpO_2$*. 6. Once you set the desired source parameter, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.
How do I enable the $MSpO_2$, Maternal Blood Oxygen Saturation, trend recorder tracing?	1. Rotate the Trim Knob to highlight the field for *$MSpO_2$*. (This field is located above the center, on the right side of the display.) 2. Once the *$MSpO_2$* field is highlighted, press the Trim Knob. The display changes to show the *$MSpO_2$ Setup* screen. 3. Now rotate the Trim Knob to highlight the *% O_2 Trace*: setting. (It should read *Off*.) 4. Once the *% O_2 Trace*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a setting of *On* (to enable $MSpO_2$ trace) or *Off*. 6. Once you set the desired trace setting, press the Trim Knob to confirm your selection. The current setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I change the scale of the $MSpO_2$, Maternal Blood Oxygen Saturation, trend recorder tracing?	1. Rotate the Trim Knob to highlight the *Setup* softkey at the bottom of the screen. 2. Once *Setup* is highlighted press the Trim Knob. Press the Trim Knob. 3. In the *General Setup* screen, rotate the Trim Knob to move the highlight to the *Service* softkey at the bottom of the screen. Press the Trim Knob. 4. The *Service Lock* screen appears. In the center of the screen are four single-digit fields below the field, *Enter Access Code.* These fields are used to enter the code to access restricted service settings in the 250 Series Monitors. The access code is the current date setting in the form of 'M M D D' or 'D D M M', where M M is the current month (01 to 12), and D D is the current date (01 through 31), however your monitor is configured. **NOTE:** The access code should reflect the *monitor's* date setting. If the monitor date is not correctly set, the access code for the actual calendar date will not work. 5. Rotate the Trim Knob to highlight each of the access code fields; press the Trim Knob, and rotate the Trim Knob to input the individual numbers that form the access code. When the last digit is entered and the Trim Knob pressed, the monitor then tests the access code. If valid, the screen changes to *Install Options Screen 1.* If invalid, the Trim Knob press does nothing. 6. Now rotate the Trim Knob to highlight the *SpO_2 Scale:* setting. (It should read *Auto* or *0-100%*.) This setting affects Maternal SpO_2 trend tracing. 7. Once the *SpO_2 Scale:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 8. Now rotate the Trim Knob to change the current setting. Select a setting of *0-100%* or *Auto*. 9. Once you set the desired trace setting, press the Trim Knob again to confirm. The current setting stops blinking. 10. To exit the Service mode, follow the instructions at the top of Page 16.
How do I change the alarm limits for $MSpO_2$, Maternal Blood Oxygen Saturation?	1. Rotate the Trim Knob to highlight the field for *$MSpO_2$*. (This field is slightly above center, on the right side of the display.) 2. Once the *$MSpO_2$* field is highlighted, press the Trim Knob. The display changes to show the *$MSpO_2$ Setup* screen. 3. Now rotate the Trim Knob to highlight the current *High*: saturation percentage (%) alarm limit setting. 4. Once the *High*: saturation percentage (%) alarm limit setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select from 100 to 85%. 6. Repeat Steps 3 through 6 for the *High*: saturation percentage (%) alarm limit setting. Select a value between *99% and 80%*. ■You may optionally change the MHR/P (Maternal Heart Rate/Pulse) *High*: select a value between *100 bpm and 250 bpm*. (The MHR/P alarm settings are also available through the *Pulse* field, or the *NIBP* field on the main monitoring screen.) ■You may optionally change the MHR/P *Low*: select a value between *35 bpm and 120 bpm*. (The MHR/P alarm settings are also available via the *Pulse* field, or the *NIBP* field on the main monitoring screen.) 7. Once the desired source parameter is set, press the Trim Knob to confirm your selection. The current value setting stops blinking. 8. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I change the waveform parameter being displayed?	1. Rotate the Trim Knob to highlight the waveform selection item. (This field is slightly above the bottom menu bar, to the far left of the display, and should indicate one of the following: *Off*, *MECG*, *MSpO$_2$*, or *FECG*.) 2. Once the waveform selection item is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 3. Now rotate the Trim Knob to change the setting to *Off*, *MECG*, *MSpO$_2$*, or *FECG*. 4. Once you set the desired source parameter, press the Trim Knob to confirm your selection. The current value setting stops blinking. 5. The selected waveform parameter displays on the main monitoring screen.
How do I change the Maternal ECG lead waveform being displayed?	**Option 1** 1. Rotate the Trim Knob to highlight the field for *MHR/P*. (This field is in the approximate center of the display and reads *MECG*, *Pulse* or *INOP*, according to the settings that are currently enabled.) 2. Once the *MECG* field is highlighted, press the Trim Knob. The display changes to show the *MHR/P Setup* screen. 3. Now rotate the Trim Knob to highlight the *Source*: setting. (It will read *Auto*, *MSpO$_2$*, *MECG* or *NIBP*.) 4. If the *Source*: setting is not *MECG*, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting to *MECG*. 6. Once you set the desired source parameter, press the Trim Knob again to save the value. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *MECG Lead*: setting. This setting is slightly above vertical center towards the right side of the screen and indicates *Lead I, II or III*. 8. Now press the Trim Knob again. The current setting displays in blinking inverse video. 9. Now rotate the Trim Knob to change the current setting to the desired lead selection. 10. Once you set the desired source parameter, press the Trim Knob to confirm your selection. The current value setting stops blinking. 11. To exit the Service mode, follow the instructions at the top of Page 16. **Option 2** 1. If the *MHR/P Source* setting is set to *Auto*, and MECG is currently enabled (plugged in) OR *MHR/P Source* is set to *MECG*, then, from the main monitor screen, rotate the Trim Knob to highlight the selected *Lead* setting for MECG. (This setting is slightly below vertical center, on the right hand side of the display. It will indicate *I, II or III*.) 2. Once the *MECG Lead* setting field is highlighted, press the Trim Knob. The current setting displays in blinking inverse video. 3. Now rotate the Trim Knob to change the current setting to *MECG Lead* setting *I, II or III*. 4. Once you set the desired source parameter, press the Trim Knob to confirm your selection. The current value setting stops blinking and the waveform should reflect the selected lead.

Question	Answer
How do I change the waveform vertical scale on the display?	1. To change the waveform scale, the current selected waveform must be *MECG* or *FECG*. The waveform scale cannot be altered when you view $MSpO_2$ plethsysmograph waveforms which auto-scale. 2. Rotate the Trim Knob to highlight the scale factor setting for the waveform display. (This setting is slightly below vertical center, on the right hand side of the display, below the horizontal speed indication of *25 mm/s.* The vertical scale indicates one of the following: *Auto, 0.25x, 0.5x, 1x, 2x, or 4x.* 3. Once the *MECG* scale setting is highlighted, press the Trim Knob. The current setting displays in blinking inverse video. 4. Now rotate the Trim Knob to change the current setting to *Auto, 0.25x, 0.5x, 1x, 2x, or 4x.* 5. Once you set the desired scale, press the Trim Knob to confirm your selection. The current value setting stops blinking, and the waveform should reflect the selected lead.
How do I disable/enable Fetal Movement Detection? (FMD is an optional feature that is purchased separately.)	1. Rotate the Trim Knob to highlight the field for *US*. (This field is top left on the display.) **NOTE:** This feature applies only if ultrasound is the source. 2. Once the *US* field is highlighted, press the Trim Knob. The display changes to show the *US Setup* screen where *US* (not *US2 Setup*) is the current field. 3. Now rotate the Trim Knob to highlight the *FM Detect:* setting. This setting is *On* or *Off*. 4. Once the *FM Detect:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value of *On* (enabled) or *Off* (disabled). 6. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I enable and change the alarm *volume* settings for Fetal Heart Rate 1?	1. Rotate the Trim Knob to highlight the field for FHR1. (This field is top left on the display, and it may read *INOP*, *FECG*, *US*, or *US2*.) 2. Once the FHR1 field is highlighted, press the Trim Knob. The display changes to show the applicable <MODE> *Setup* screen, where <MODE> is the current field. 3. Now rotate the Trim Knob to highlight the FHR1 *Audio Alarms:* setting. This is at the bottom of the flat panel display, slightly above the menu bar, on the left half of the screen. The setting is either *On* or *Off*. If the setting is *Off*, it needs to be enabled. Proceed to Step 4 below. If it is already *On*, and you simply wish to change the *Volume*: setting, proceed to Step 7 below. 4. Once the *Audio Alarms:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting to *On*. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Volume*: setting which is located immediately to the right. The setting is in the range of *1 to 9.* 8. Once the *Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video, and an audio tone, indicative of the alarm volume, is emitted from the speaker. 9. Now rotate the Trim Knob to change the current setting, as desired. Each time you change a setting, you will hear an audio tone, indicative of the alarm volume, emitted from the speaker. 10. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. A final audio tone, indicative of the alarm volume, is emitted from the speaker. 11. To exit the Service mode, follow the instructions at the top of Page 16.
How do I enable or change alarm *volume* settings for Fetal Heart Rate 2?	1. Rotate the Trim Knob to highlight the field for FHR2. (This field is top left on the display, and may display as *INOP* or *US2*. 2. Once the FHR2 field is highlighted, press the Trim Knob. The display changes to show the applicable <MODE> *Setup* screen, where mode is the current field. 3. Now rotate the Trim Knob to highlight the FHR2 *Audio Alarms:* setting. This is at the bottom of the flat panel display, slightly above the menu bar, on the left half of the screen. The setting is either *On* or *Off*. If the setting is *Off*, you must enable it. Proceed to (Step 4) below. If the setting is already *On*, and you simply wish to change the *Volume*: setting, proceed to (Step 7) below. 4. Once the *Audio Alarms:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting to *On*. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Volume*: setting located immediately to the right. The setting is in the range of *1 to 9.* 8. Once the *Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video, and an audio tone, indicative of the alarm volume, will be emitted from the speaker. 9. Now rotate the Trim Knob to change the current setting as desired. With each setting change, an audio tone, indicative of the alarm volume, will be emitted from the speaker. 10. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. A final audio tone, indicative of the alarm volume, is emitted from the speaker. 11. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I enable or change alarm *volume* settings for Non-Invasive Blood Pressure?	1. Rotate the Trim Knob to highlight the field for *NIBP*. (This field is slightly above center, on the left side of the display.) 2. Once the *NIBP* field is highlighted, press the Trim Knob. The display changes to show the *NIBP Setup* screen. 3. Now rotate the Trim Knob to select (highlight) the *Volume*: setting which is located immediately to the right. The setting is in the range of *1 to 9.* 4. Once the *Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video, and an audio tone, indicative of the alarm volume, is emitted from the speaker. 5. Now rotate the Trim Knob to change the current setting as desired. Each time you change a setting, an audio tone, indicative of the alarm volume, will be emitted from the speaker. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. A final audio tone, indicative of the alarm volume, is emitted from the speaker. 7. To exit the Service mode, follow the instructions at the top of Page 16.
How do I enable or change alarm *volume* settings for MHR/P (Maternal Pulse)?	1. Rotate the Trim Knob to highlight the field for *MHR/P*. (This field is located approximately in the center of the display, and may indicate *MECG*, *Pulse* or *INOP*, depending on the settings that are currently enabled. 2. Once the *MHR/P* field is highlighted, press the Trim Knob. The display changes to show the *MHR/P Setup* screen. 3. Now rotate the Trim Knob to select (highlight) the *Alarm Volume*: setting located immediately to the right. The setting is in the range of *1 to 9.* 4. Once the *Alarm Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video, and an audio tone, indicative of the alarm volume, is emitted from the speaker. 5. Now rotate the Trim Knob to change the current setting as desired. With each setting change, an audio tone, indicative of the alarm volume, will be emitted from the speaker. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. A final audio tone, indicative of the alarm volume, is emitted from the speaker. 7. To exit the Service mode, follow the instructions at the top of Page 16.
How do I enable or change alarm *volume* settings for Maternal Blood Oxygen Saturation ($MSpO_2$)?	1. Rotate the Trim Knob to highlight the field for *$MSpO_2$*. (This field is located slightly above center, on the right side of the display.) 2. Once the *$MSpO_2$* field is highlighted, press the Trim Knob. The display changes to show the *$MSpO_2$ Setup* screen. 3. Now rotate the Trim Knob to select (highlight) the *Alarm Volume*: setting which is located immediately to the right. The setting is in the range of *1 to 9*. 4. Once the *Alarm Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video, and an audio tone, indicative of the alarm volume, is emitted from the speaker. 5. Now rotate the Trim Knob to change the current setting as desired. With each setting change, an audio tone, indicative of the alarm volume, will be emitted from the speaker. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. A final audio tone, indicative of the alarm volume, is emitted from the speaker. 7. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I change the *Volume* for FHR1 audio or heart beat tones?	**Option 1** 1. Use the front panel **Volume** Up or **Volume** Down buttons (left) to control volume for FHR Channel 1. **Option 2** 1. Rotate the Trim Knob to highlight the field for FHR1. (This field is top left on the display, and it may read *INOP*, *FECG*, *US*, or *US2*. However, to be able to alter the volume with this method, you must enable one FHR1 mode by inserting a transducer into the appropriate connector on the front of the monitor.) 2. Once the FHR1 field is highlighted, press the Trim Knob. The display changes to show the applicable <MODE> *Setup* screen, where mode is the current field. 3. Now rotate the Trim Knob to highlight the FHR1 *Volume*: setting which is located slightly above vertical center, on the left, next to the volume bar graph. 4. Once the *Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current volume setting. Select a value between *0* and *9*. As the setting is changes, the bar graph changes to reflect the current setting. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.
How do I change the *volume* for FHR2 audio or heart beat tones?	**Option 1** 1. Use the front panel **Volume** Up or **Volume** Down buttons (right) to control volume for FHR Channel 2. **Option 2** 1. Rotate the Trim Knob to highlight the field for FHR2. (This field is top left on the display, and it may read *INOP* or *US2*. However, to be able to alter the volume using this method, you must enable one FHR2 mode by inserting a transducer into the appropriate connector on the front of the monitor) 2. Once the FHR2 field is highlighted, press the Trim Knob. The display changes to show the applicable <MODE> *Setup* screen, where mode represents the current field. 3. Now rotate the Trim Knob to highlight the FHR2 *Volume*: setting which is located slightly above vertical center, on the left, next to the volume bar graph. 4. Once the *Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current volume setting. Select a value between *0* and *9*. As the setting changes, the bar graph changes to reflect the current setting. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I change the volume for MHR Pulse tones?	1. Rotate the Trim Knob to highlight the field for *MHR/P*. (This field is located near the center of the display, and may indicate *MECG*, *Pulse* or *INOP*, depending on the settings that are currently enabled. 2. Once the *MHR/P* field is highlighted, press the Trim Knob. The display changes to show the *MHR/P Setup* screen. 3. In the *MHR/P Setup* screen, rotate the Trim Knob to highlight *Volume:* setting. This setting is at the vertical center in the left half of the display, next to the *Volume:* bar graph. 4. Once the *Volume:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current volume setting. Select a value between *0 and 9.* As the setting changes, the bar graph changes to reflect the current setting. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions on Page 16.
How do I change the volume for NIBP completion indication?	1. Rotate the Trim Knob to highlight the field for *NIBP*. (This field is slightly above center, on the left side of the display. 2. Once the *NIBP* field is highlighted, press the Trim Knob. The display changes to show the *NIBP Setup* screen. 3. In the *NIBP Setup* screen, rotate the Trim Knob to highlight the *NIBP Done Vol:* setting. This setting is slightly above vertical center, in the right half of the display, next to the *NIBP Done Vol:* bar graph. 4. Once the *NIBP Done Vol:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current volume setting. Select a value between *0 and 9.* As the setting changes, the bar graph changes to reflect the current setting. With each change, an audio tone, that reflects the selected audio level, is heard. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I access the service setup / install options screens?	1. Rotate the Trim Knob to highlight the *Setup* softkey at the bottom of the display, below the menu bar. 2. Once the *Setup* softkey is highlighted, press the Trim Knob. 3. The display changes to show the *General Setup* screen. 4. In the *General Setup* screen, rotate the Trim Knob to move the highlight to the *Service* softkey which is located at the bottom of the display, below the menu bar. 5. Once the *Service* softkey is highlighted, press the Trim Knob. 6. The display changes to show the *Service Lock* screen. There are four single-digit fields in the center of the screen, below the field, *Enter Access Code.* Enter the code to access restricted service settings in the 250 Series Monitors in these fields. The access code is the current date setting in the form of 'M M D D' or 'D D M M', where M M is the current month (0 1 to 1 2), and D D is the current date (0 1 through 3 1). **NOTE:** The access code should reflect monitor's date setting. If the monitor date is incorrectly set, the access code for the actual calendar date will not work. 7. Rotate the Trim Knob to highlight each of the access code fields. Press the Trim Knob, and rotate the Trim Knob to input the individual numbers that form the access code. When you enter the last digit and press the Trim Knob, the monitor tests the access code. If valid, the screen changes to the *Install Options Screen 1*. If invalid, the Trim Knob press does nothing. 8. To exit the Service mode, follow the instructions at the top of Page 16. **NOTE:** Selecting *Store Current to Hospital* automatically sets the *Default Settings:* to *Hospital.*
How do I set/change RS232 serial communications baudrates and protocols?	1. Enter *Install Options Screen 1*. (Refer to, "How do I access the service setup / install options screens?" on page 5-27) 2. In *Install Options Screen 1*, rotate the Trim Knob to highlight the *COMM* softkey at the bottom of the display, below the menu bar. 3. Press the Trim Knob to enter the *Communications Setup* screen. 4. On the *Communications Setup* screen, the three items in the column at the far left represent the Rear Panel RS232 Communications Port designations **J109, J110** and **J111.** The middle column represents the current *Baudrate* for the associated communications port (same line reading across), and the last column on the right represents the communications protocol for the associated communications port. Baudrates and protocols for all three ports are configurable. 5. To change a *Baudrate*, rotate the Trim Knob to highlight the desired baudrate selection on the desired communication port line. 6. Press the Trim Knob. The current setting displays in blinking inverse video. 7. Now rotate the Trim Knob to change the current baudrate setting. Select from *600, 1200, 2400, 4800, 9600,* and *19200.* 8. When the desired baudrate displays, press the Trim Knob again to save.Once selected, the setting stops blinking. 9. To change a protocol, rotate the Trim Knob to highlight the desired protocol selection on the desired communication port line. 10. Press the Trim Knob. The current setting displays in blinking inverse video. 11. Now rotate the Trim Knob to change the current setting. Select from the options in the following table on the associated communications ports. 12. To exit the Service mode, follow the instructions at the top of Page 16. **NOTE:** All ports do not support all protocols.

J109	J110	J111
115	115	115
115 X/R	115 X/R	115 X/R
Loopback (test)	Loopback (test)	Loopback (test)
Critikon	Critikon	Critikon
1371 (HP)	1371 (HP)	1371 (HP)
1371 Notes (HP)	1371 Notes (HP)	1371 Notes (HP)
Nellcor	Factory (test only)	Nellcor

Question	Answer
	13. When the desired baudrate is displayed, press the Trim Knob again to save. 14. Repeat Steps 7 through 12 for each communications port. 15. To exit the Service mode, follow the instructions at the top of Page 16.
How do I enable/disable Heart Beat Coincidence?	1. Enter *Install Options Screen 1*. (Refer to, "How do I access the service setup / install options screens?" on page 5-27.) 2. In *Install Options Screen 1*, rotate the Trim Knob to highlight the *HBC:* setting on the eleventh line from the top (excluding the Title). 3. The current setting is either *On* (enabled) or *Off* (disabled). 4. Once the *HBC*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current volume setting. Select a value. 6. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.
How do I change recorder font size?	1. Enter the *Install Options Screen 1*. (Refer to, "How do I access the service setup / install options screens?" on page 5-27). 2. In the INSTALL OPTIONS screen, rotate the Trim Knob to highlight the *Recorder Font Size:* setting. 3. The current setting is *Small, Medium or Large*. 4. Once the *Recorder Font Size:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current volume setting. Select a value. 6. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I enable/disable *Smart BP?*	1. Enter *Install Options Screen 1*. (Refer to, "How do I access the service setup / install options screens?" on page 5-27). 2. In *Install Options Screen 1*, rotate the Trim Knob to highlight the *Smart BP*: setting. 3. The current setting is ON (enabled) or *Off* (disabled). 4. Once the *Smart BP*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current volume setting. Select a value. 6. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.
How do I change the interval time for taking Non-Invasive Blood Pressures?	1. Rotate the Trim Knob to highlight the field for *NIBP*. (This field is slightly above center, on the left side of the display.) 2. Once the *NIBP* field is highlighted, press the Trim Knob. The display changes to show the *NIBP Setup* screen. 3. Now rotate the Trim Knob to highlight the *Mode*: setting which is below the *NIBP Setup* title. The current setting is one of the following: *Manual, Auto 1 min, Auto 2 min, Auto 3 min, Auto 4 min, Auto 5 min, Auto 10 min, Auto 20 min, Auto 30 min, Auto 40 min, Auto 45 min, Auto 60 min, Auto 90 min, or Auto 120 min.* 4. Once the *Mode*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value from one of the following: *Manual, Auto 1 min, Auto 2 min, Auto 3 min, Auto 4 min, Auto 5 min, Auto 10 min, Auto 20 min, Auto 30 min, Auto 40 min, Auto 45 min, Auto 60 min, Auto 90 min, or Auto 120 min.* 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.
How do I change the display time-out duration for Non-Invasive Blood Pressures?	1. Navigate to *Install Options Screen 2*. 2. Now rotate the Trim Knob to highlight the *NIBP Display*: setting. The current setting is one of the following: *On* (do not blank last NIBP taken), *1 min Blank* (blank last NIBP taken after 1 minute), *2 min Blank, 3 min Blank, 5 min Blank, 10 min Blank, 15 min Blank, 30 min Blank.* 3. Once the *Display*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 4. Now rotate the Trim Knob to change the current setting. Select one of the following: *On*, *1 min Blank, 2 min Blank, 3 min Blank, 5 min Blank, 10 min Blank, 15 min Blank, 30 min Blank.* 5. Once you set the desired *NIBP Display*: value, press the Trim Knob again to save the value. The current value setting stops blinking. 6. To exit the Service mode, follow the instructions at the top of Page 16.
How do I activate and terminate Heart Rate Offset? Now in *Install Options Screen 2*	1. Press and hold the **Mark [Offset]** button (over the recorder) on the front panel of the 250 Series Monitor for 2 seconds. You will hear a short, two-tone audio beep from the monitor when offset is activated. 2. To end the HR offset period, press and hold the **Mark [Offset]** button (over the recorder) again for 2 seconds. You will hear a short, two-tone audio beep from the monitor when *HR Offset* is *Off*.
How do I know when the monitor detects Heart Beat Coincidence?	Heart Beat Coincidence (*HBC*) indicates that two HR channels may be monitoring the same signal by placing both heart rates in inverse video on the front panel display, AND by placing a symbol of two overlapping hearts on the trend recorder.

Question	Answer
How do I change the default tocodynamometer reference value?	1. Enter *Install Options Screen 2*. (Refer to "How do I access the service setup / install options screens?" on page 5-27.) 2. In *Install Options Screen 2*, rotate the Trim Knob to highlight the *Default TOCO Reference*: setting on the eighth line from the top (excluding the Title). 3. The current setting is one of the following: *5, 10, 15, 20* or *25 mmHg.* 4. Once the *Default TOCO Reference*: setting is highlighted, press the Trim Knob. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value. 6. Once the desired value is set, press the Trim Knob again to save the value. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.
How do I change the date?	1. Rotate the Trim Knob to highlight the *Setup* softkey at the bottom of the display, below the menu bar. 2. Once the *Setup* softkey is highlighted, press the Trim Knob. 3. The display will change to the *General Setup* screen. 4. In the *General Setup* screen, rotate the Trim Knob to highlight one of the *Date:* setting fields on the top right corner of the display. These fields are for day (DD), month (MMM), and year (YYYY). 5. After the desired field is highlighted (selected), press the Trim Knob. The current setting displays in blinking inverse video. 6. Now rotate the Trim Knob to change the current date parameter setting. 7. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 8. Repeat Step 4 through Step 7 for any other date parameters that need to be set. 9. To exit the Service mode, follow the instructions at the top of Page 16.
How do I change the time?	1. Rotate the Trim Knob to highlight the *Setup* softkey at the bottom of the display, below the menu bar. 2. Once the *Setup* softkey is highlighted, press the Trim Knob. 3. The display changes to the *General Setup* screen. 4. In the *General Setup* screen, rotate the Trim Knob to highlight one of the *Time:* setting fields on the top left corner of the display. These fields are for hours (HH), minutes (MMM), and seconds (YYYY). Note that the seconds field cannot be selected or set. 5. After the desired field is highlighted (selected), press the Trim Knob. The current setting displays in blinking inverse video. 6. Now rotate the Trim Knob to change the current time parameter setting. 7. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 8. Repeat Step 4 through Step 7 for any other date parameters that need to be set. 9. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I change the Recorder Paper Speed?	1. Enter the *Install Options Screen 1*. 2. Rotate the Trim Knob to highlight the *Paper Speed:* setting in the *Recorder Setup* section of the *General Setup* screen (center section of the display). 3. The current setting is one of the following: *1, 2,* or *3 cm/min.* 4. Once the *Paper Speed:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value. 6. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.
How do I enable the maternal-only recorder mode?	1. From the *On* state, (The yellow LED above the recorder is illuminated.), press the **Record** button once quickly. The recorder advances, printing the date and time on the chart paper perpendicular (rather than parallel) to the direction of paper travel. Then the recorder halts and the yellow LED flashes intermittently to indicate MATERNAL ONLY mode is enabled. 2. From the *Off* state, (The yellow LED above the recorder is off.), press the **Record** button twice quickly. The recorder advances, printing the date and time on the chart paper perpendicular (rather than parallel) to the direction of paper travel. Then the recorder halts and the yellow LED flashes intermittently to indicate MATERNAL ONLY mode is enabled.
How do I turn off the recorder completely?	From the *On* or MATERNAL ONLY state, (The yellow LED above the recorder is illuminated or flashing intermittently.), press the **Record** button and hold for 2 seconds, until the monitor emits a two tone audio beep which indicates that the recorder is off. The yellow LED is now extinguished.
How do I change the LOW PAPER/NO PAPER alarm conditions?	1. Enter the *Install Options Screen 1*. Rotate the Trim Knob to highlight the *Paper Chime*: setting. 2. The current setting is one of the following: *Off* (no audio for any 'no paper' or 'low paper' condition), *Out Only* (audio tone on 'paper out' only), or *Low/Out* (audio tone for any *LOW PAPER/NO PAPER* condition). 3. Once the *Paper Chime*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 4. Now rotate the Trim Knob to change the current setting. Select a value. 5. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 6. To exit the Service mode, follow the instructions at the top of Page 16.
How do I change the Heart Rate Recorder Scale?	1. Enter the *Install Options Screen 1*. ("How do I access the service setup / install options screens?" on page 5-27). 2. In *Install Options Screen 1*, rotate the Trim Knob to highlight the *Scaling:* setting. 3. The current setting is either *30-240* or *50-210 bpm*. 4. Once the *Scaling*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value. 6. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I enable/disable Fetal Alarms (tachycardia, bradycardia) or Spectra Alerts?	1. Enter the *Install Options Screen 2*. ("How do I access the service setup / install options screens?" on page 5-27). 2. In *Install Options Screen 2*, rotate the Trim Knob to highlight the *Fetal Alert/Alarm*: setting. 3. The current setting is *Off* or *Alarms*. In units where Spectra Alerts have been factory configured, a third option called *Alerts* appears. 4. Once the *Fetal Alert/Alarm*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value. 6. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 7. To exit the Service mode, follow the instructions at the top of Page 16.
How do I test the analog outputs from J102?	1. Enter the *Install Options Screen 1*. ("How do I access the service setup / install options screens?" on page 5-27). 2. In *Install Options Screen 1*, rotate the Trim Knob to highlight the *Tests* softkey at the bottom of the display, below the menu bar. This opens the *Diagnostic Control* screen. 3. Rotate the Trim Knob to highlight the *J102* softkey at the bottom of the display, below the menu bar. This opens the *J102* screen. The *J102* connector is where HR and UA parameters are available as analog voltages at the rear panel of your monitor. 4. The *J102* screen is divided into five columns: *Pin, Signal, Range, Voltage,* and *Meaning.* ◆ *Pin* refers to the physical pinout of the connector. ◆ *Signal* is the signal schematic designation. ◆ *Range* is the expected range of outputs under normal operating conditions. ◆ *Voltage* is the actual voltage that should be noted at the indicated *Pin* (using a DVM referenced to Pin 3, ANALOG GND) while running these tests. ◆ *Meaning* is intended interpretation of the voltage indicated in the *Voltage* field to an external device. 5. To test these outputs, rotate the Trim Knob to the desired row (*Pin*). The cursor can only move up and down through the last column. 6. Once the desired row is selected, press the Trim Knob. The current setting (*Meaning*) displays in blinking inverse video. 7. Now rotate the Trim Knob. As the Trim Knob rotates, the value in the *Meaning* column change, as will the voltage indicated in the *Voltage* column. This same voltage should be seen at the J102 Connector Pin. 8. Once the desired value / pinout is tested and calibrated, press the Trim Knob again to end the value test. The current value setting stops blinking. 9. Repeat Steps 5 through 8, as required. 10. To exit the Service mode, follow the instructions at the top of Page 16.

Question	Answer
How do I perform the recorder calibration test?	1. Enter *Install Options Screen 1*. ("How do I access the service setup / install options screens?" on page 5-27.) 2. In *Install Options Screen 1*, rotate the Trim Knob to highlight the *Tests* softkey at the bottom of the display, below the menu bar. This opens the *Diagnostic Control* screen. 3. In the *Diagnostic Control* screen, rotate the Trim Knob to select the *Recorder Calibration:* setting. This should be *Off*. 4. Now press the Trim Knob. The current setting (*Off*) displays in blinking inverse video. 5. Rotate the Trim Knob to change the setting to *On*, and press the Trim Knob again. 6. The recorder should now begin to print two distinct calibration mechanisms: ◆ Continuous calibration lines at the upper and lower limits of the heart rate and uterine activity scales. This is to aid in the alignment of the print head assembly. ◆ Approximately every 3/16 in, a full line will print from end to end. This is to test all print head elements and align the print head to the roller tangent. 7. Once the desired tests are complete, press the Trim Knob again. The *On* setting displays in blinking inverse video. To end the test, rotate the Trim Knob to change the current setting to *Off*, and press the Trim Knob again to save. The current value setting stops blinking. 8. To exit the Service mode, follow the instructions at the top of Page 16. **NOTE:** Recorder calibration cannot be saved.

Question	Answer
How do I test the RS232 outputs?	1. The 250 Series Monitor Serial Interface is capable of being tested by means of a loop back connector. A loop back connector simply routes the TX line from the serial port to the RX line of the same serial port. 2. Enter the *Install Options Screen 1*. ("How do I access the service setup / install options screens?" on page 5-27.) 3. In the *Install Options Screen 1*, rotate the Trim Knob to highlight the *COMM* softkey at the bottom of the display below the menu bar. 4. Press the Trim Knob to enter the *Communications Setup* screen. 5. On the *Communications Setup* screen, the three items in the column at the far left represent the rear panel RS232 Communications Port designations **J109, J110** and **J111.** The middle column represents the current *Baudrate* for the associated communications port (same line reading across), and the last column on the right represents the communication protocol for the associated communication port. 6. To change a *Baudrate*, rotate the Trim Knob to highlight the desired baudrate selection on the desired communication port line. 7. Press the Trim Knob. The current setting displays in blinking inverse video. 8. Now rotate the Trim Knob to change the current baudrate setting. Select from one of the following: *600, 1200, 2400, 4800, 9600,* and *19200.* 9. When the desired test baudrate displays, press the Trim Knob again to save. The current value stops blinking. 10. Note the current protocol setting so that it may be reset when testing is completed. 11. Then rotate the Trim Knob to highlight the protocol selection of the desired communication port line. 12. Press the Trim Knob. The current setting displays in blinking inverse video. 13. Now rotate the Trim Knob to change the current setting to *Loopback*. 14. The column immediately to the right now displays a new indication, *Off*. 15. Insert the loopback connector in the corresponding rear panel serial port connector. Within a few seconds the *Off* indication should change to *OK*. 16. Return the protocol setting to the setting previously noted, and press the Trim Knob to save. The current value stops blinking. 17. Repeat Steps 6 through 16 for each of the serial ports. 18. To exit the Service mode following the instructions at the top of Page 16.

Question	Answer
How can I see all the current settings for my monitor?	1. Enter the *Install Options Screen 1*. ("How do I access the service setup / install options screens?" on page 5-27.) 2. In the *Install Options Screen 1*, rotate the Trim Knob to highlight the *PrintAll* softkey at the bottom of the display, below the menu bar. This initiates the *PrintAll* function. 3. The display will change to one of the setup screens, and the printer will start. The printer will output a hardcopy version of the setup screen that is displayed. 4. After the first setup screen prints, the display switches to the next setup screen, and again the printer outputs a hardcopy version of this screen. 5. *PrintAll* will output in order, recopies of the following setup screens: ◆ *Setup* (256 and 259 models) ◆ *FECG* or *US* (256 and 259 models) ◆ *NIBP Setup* (259 model only) ◆ *MHR/P Setup* (259 model only) ◆ *MSpO$_2$ Setup* (259 model only) ◆ *Vital Signs History* (256 and 259 models) ◆ *Master Alarm Setup* (259 model only) ◆ *General Setup* (256 and 259 models) ◆ *Install Options Screen 1* (256 and 259 models) ◆ *Install Options Screen 2* (256 and 259 models) ◆ *Communications Setup* (256 and 259 models) ◆ *Diagnostic Control* (256 and 259 models) 6. Wait until the printer stops and the display returns to the *Install Options Screen 1* before you exit the Service mode. 7. To exit the Service mode following the instructions at the top of Page 16.
I have made the monitor configuration changes I want, but they are not being stored. Why?	Refer to "How are the 250 configurations settings stored and recalled?" on page 5-16.
How can I change the analog output voltages from Corometrics standard to Hewlett-Packard / Phillips standard?	1. The analog voltage outputs at J102 may conform to one of two voltage standards for analog central station outputs: Corometrics or Hewlett-Packard. The default is Corometrics. 2. To change the setting, remove the unit cover. 3. At the rear of the unit, on the main CPU motherboard, below the communications board, there is an 8 bit DIP switch, SW1. 4. Switch number 2 determines the analog output standard used by the 250 Series Monitor. ◆ If switch number 2 is on (closed), the output voltages comply with the Corometrics standard. ◆ If switch number 2 is off (open), the output voltages comply with the Hewlett-Packard Standard.

Question	Answer
How do I check the settings of the Main CPU Board dip switch SW1 without opening the unit?	1. Enter the *Install Options Screen 1*. ("How do I access the service setup / install options screens?" on page 5-27.) 2. In the *Install Options Screen 1*, rotate the Trim Knob to highlight the *Test* softkey at the bottom of the display below the menu bar. This opens the *Diagnostic Control* screen. 3. At the bottom of the *Diagnostic Control* screen, the field *SW1* appears followed by a total of 8 ones and zeros. These represent the state of the dip switch settings on the motherboard. The dip switch positions are left to right, Switch 8 to Switch 1. ◆ A 1 indicates the switch is open (Off), and the associated signal is enabled. ◆ A 0 indicates the switch is closed (On), and the associated signal is disabled. 4. The eight switches are defined as in the following table. 5. On the line immediately below the dip switch settings, the current configuration is interpreted as text information. For instance, when the dip switch settings indicate 11101100, the configuration line will read "*MECG MSpO$_2$ NIBP CORO* "to indicate that MECG, MSpO$_2$ and NIBP are enabled, and that the J102 outputs voltage levels are set to the Corometrics Analog Interface Standard. 6. To exit the Service mode following the instructions at the top of Page 16.

Switch Positions	Description	Text Interpretation
SW1	Factory Test	TEST or <blank>
SW2	J102 Outputs	CORO or <blank>
SW3	Unused	<blank>
SW4	Clock Speed 16/20 MHz	NIBP or <blank>
SW5	Unused	<blank>
SW6	NBP Option	NBP or <blank>
SW7	MSpO$_2$ Option	MSpO$_2$ or <blank>
SW8	MECG Option	MECG or <blank>

System Troubleshooting

The following Section will aid in the troubleshooting and repair of your monitor. Each of the following sub-sections begins with a general fault description, followed by a list of possible causes and debugging hints. Before looking through the listed problems, attempt to verify the reported problem. It is important to verify the reported problem, whenever possible. This way you can insure, in the end, that the repair effort was effective. If you are able to duplicate the reported problem, inspect the monitor, accessories, connectors, cables, etc., in the area affected. If you are unable to find anything obvious, or you are unable to verify the reported problem, follow the step by step.

250 SERIES SERVICE & TROUBLE SHOOTING		
PROBLEM	**SUBASSEMBLY**	**COMMENTS**
VIDEO		
	COMM BOARD WITH I/O CONNECTORS	Sits on same data bus as DSP/Display board
	SYSTEM POWER SUPPLY	
	INVERTOR	If display is very dim
	INVERTOR TO LCD PANEL CABLE	If display is very dim
	DSP TO INVERTOR CABLE	Video goes over this cable
	MAIN BOARD	Generates video and sends to DSP
	LCD PANEL	
	ENCODER BOARD	Video and color affected by this board
	ENCODER TO LCD PANEL CABLE	Video and color goes over this cable
	DSP BOARD	Holds Graphic Generator
	DSP TO ENCODER CABLE	Video goes over this cable
	FAN	Secondary failure due to overheating only
AUDIO		
	MAIN BOARD	Generates FECG/MECG/SpO_2 audio, gets Ultrasound audio from DSP
	DSP BOARD	Processes US, FECG, & MECG analog and could affect
	VOLUME KEYPAD	
	SPEAKER	

250 SERIES SERVICE & TROUBLE SHOOTING		
PROBLEM	**SUBASSEMBLY**	**COMMENTS**
	SYSTEM POWER SUPPLY	
	FRONT-END MOTHERBOARD	Passes all front-end signals. Make sure boards seated and no connector damage exists.
	ULTRASOUND BOARD	Can affect ultrasound audio only if US board is bad
	ISOLATED POWER SUPPLY	By affecting ECG - does not affect ultrasound
	UI KEYPAD BOARD	Would affect all buttons on front panel.
	DSP TO UI KEYPAD CABLE	Would affect all buttons on front panel.
	UI TO VOLUME BOARD CABLE	Could affect only volume and alarm cancel
	COMM BOARD WITH I/O CONNECTORS	Sits on same data bus as DSP/Display board
	FAN	Secondary failure due to overheating only
FECG		
	FECG FRONT-END CABLE & CONNECTOR	Usually Bad Connector Crimps
	ISOLATED POWER SUPPLY	
	FRONT-END MOTHERBOARD	Passes all front-end signals -make sure boards seated & no connector damage
	FECG/UA BOARD	
	DSP BOARD	Processes FECG analog
	SYSTEM POWER SUPPLY	
	MAIN BOARD	Processes for display
	COMM BOARD WITH I/O CONNECTORS	Sits on the same data bus as DSP Display Board
UA		
	ISOLATED POWER SUPPLY	
	UA FRONT-END CABLE & CONNECTOR	Usually bad connector crimps
	DSP BOARD	Processes UA analog
	FRONT-END MOTHERBOARD	Passes all front-end signals -make sure boards seated & no connector damage
	FECG/UA BOARD	
	SYSTEM POWER SUPPLY	
	MAIN BOARD	Processes for display

250 SERIES SERVICE & TROUBLE SHOOTING		
PROBLEM	**SUBASSEMBLY**	**COMMENTS**
	TRANSDUCER	
	COMM BOARD WITH I/O CONNECTORS	Sits on same data bus as DSP/Display board
	FAN	Secondary failure due to overheating only
MECG		
	ISOLATED POWER SUPPLY	
	MECG BOARD	
	DSP BOARD	Processes MECG analog
	MECG FRONT-END CABLE & CONNECTOR	Usually bad connector crimps
	FRONT-END MOTHERBOARD	Passes all front-end signals -make sure boards seated & no connector damage
	MAIN BOARD	Processes for displaying
	FECG/UA BOARD	Can affect board, try removing
	SYSTEM POWER SUPPLY	
	COMM BOARD WITH I/O CONNECTORS	Sits on same data bus as DSP/Display board
	FAN	Secondary failure due to overheating only.
$MSpO_2$		
	$MSpO_2$ FRONT PANEL CONNECTOR BOARD	More likely internal cable
	$MSpO_2$ MODULE	
	FRONT-END MOTHERBOARD	Passes all front-end signals -make sure boards seated & no connector damage
	ISOLATED POWER SUPPLY	
	$MSpO_2$ FRONT-END CABLE	Usually bad connector crimps
	$MSpO_2$ CARRIER BOARD	Insure board seated properly
	SYSTEM POWER SUPPLY	
	MAIN BOARD	Processes for display
	DSP BOARD	Just routes traces to Main board
	FAN	Secondary failure due to overheating only

250 SERIES SERVICE & TROUBLE SHOOTING		
PROBLEM	**SUBASSEMBLY**	**COMMENTS**
NIBP		
	MAIN BOARD	Contains NIBP processor and sensors
	PNEUMATICS BOARD (PUMP & VALVES)	Holds Pump, valves, hoses
	HOSES	To front panel, Pneumatics to main
	SYSTEM POWER SUPPLY	
	DSP TO UI KEYPAD CABLE	Could affect **NIBP Start/Stop** button
	UI KEYPAD BOARD	Would affect all buttons on front panel
	FAN	Secondary failure due to overheating only
ULTRASOUND 1		
	DSP BOARD	Processes US1 analog
	ULTRASOUND FRONT-END CABLES	Usually bad connector crimps
	ULTRASOUND BOARD	If US1 heart rate is displayed on US2, cables swapped on US board
	FRONT-END MOTHERBOARD	Passes all front-end signals -make sure boards seated & no connector damage
	SYSTEM POWER SUPPLY	
	MAIN BOARD	Processes for display
	COMM BOARD WITH I/O CONNECTORS	Sits on same data bus as DSP/Display board
	FAN	Secondary failure due to overheating only
ULTRASOUND 2		
	ULTRASOUND BOARD	If US1 heart rate is displayed on US2, cables swapped on US board
	DSP BOARD	Processes US2 analog
	ULTRASOUND FRONT-END CABLES	Usually bad connector crimps
	FRONT-END MOTHERBOARD	Passes all front-end signals -make sure boards seated & no connector damage
	MAIN BOARD	Processes for display
	SYSTEM POWER SUPPLY	
	FAN	Secondary failure due to overheating only
	COMM BOARD WITH I/O CONNECTORS	Sits on same data bus as DSP/Display board

250 SERIES SERVICE & TROUBLE SHOOTING		
PROBLEM	**SUBASSEMBLY**	**COMMENTS**
COMM		
	MAIN BOARD	Generates all external comm
	COMM BOARD WITH I/O CONNECTORS	
	SYSTEM POWER SUPPLY	
	DSP BOARD	Sits on the same data bus from main board
	FAN	Secondary failure due to overheating only
PRINTING		
	RECORDER BOARD	Receives data from main board
	RECORDER BOARD TO PRINTHEAD CABLE	Data to printhead goes through this
	MAIN BOARD	Generates data for printing
	RECORDER MOTOR	Could have open winding or bad wire crimp in connector
	DOOR SWITCH	Will not print if main boards thinks door is open
	RECORDER BOARD TO DOOR SWITCH CABLE	Will not print if main boards thinks door is open
	SYSTEM POWER SUPPLY	
	UI KEYPAD BOARD	Would effect all buttons on front panel
	FAN	Secondary failure due to overheating only
PAPER ADVANCE		
	DSP TO UI KEYPAD CABLE	Affects all front panel functions
	RECORDER MOTOR	Could have open winding or bad wire crimp in connector
	UI KEYPAD BOARD	Would affect all buttons on front panel
	RECORDER BOARD TO MAIN BOARD CABLE	
	RECORDER BOARD	Controls go through this board
	DOOR SWITCH	Will not print if main boards thinks door is open
	MAIN BOARD	Communicates with keypad
	SYSTEM POWER SUPPLY	
	RECORDER BOARD TO DOOR SWITCH CABLE	Same as printing

250 SERIES SERVICE & TROUBLE SHOOTING		
PROBLEM	**SUBASSEMBLY**	**COMMENTS**
	PRINTHEAD	Misalignment causing drag
	DSP BOARD	Front panel keypad routed through DSP board
	FAN	Secondary failure due to overheating only
VOLUME CONTROLS		
	UI KEYPAD BOARD	Would affect all buttons on front panel
	MAIN BOARD	Communicates with keypad
	VOLUME KEYPAD	Affects volume and alarm cancel
	UI TO VOLUME BOARD CABLE	Affects volume and alarm cancel
	DSP TO UI KEYPAD CABLE	Affects all front panel functions
	SYSTEM POWER SUPPLY	
	DSP BOARD	Front panel keypad routed through DSP board
	FAN	Secondary failure due to overheating only
RECORDER BUTTON: RECORDER ON		
	RECORDER BOARD TO MAIN BOARD CABLE	
	UI KEYPAD BOARD	Would affect all buttons on front panel
	RECORDER BOARD	Drives the stepper motor
	DSP TO UI KEYPAD CABLE	Affects all front panel functions
	RECORDER MOTOR	Could have open winding or bad wire crimp in connector
	DOOR SWITCH	Will not print if main boards thinks door is open
	MAIN BOARD	Communicates with keypad
	SYSTEM POWER SUPPLY	
	DSP BOARD	Front panel keypad routed through DSP board
	FAN	Secondary failure due to overheating only
UI BUTTON: UA REF		
	DSP TO UI KEYPAD CABLE	Affects all front panel functions
	UI KEYPAD BOARD	Would affect all buttons on front panel
	SYSTEM POWER SUPPLY	
	MAIN BOARD	Communicates with keypad
	DSP BOARD	Front panel keypad routed through DSP board

250 SERIES SERVICE & TROUBLE SHOOTING		
PROBLEM	**SUBASSEMBLY**	**COMMENTS**
	FAN	Secondary failure due to overheating only
	TOCO OR STRAIN GAUGE TRANSDUCER	Try another transducer
TEST FUNCTION		
	DSP TO UI KEYPAD CABLE	Affects all front panel functions
	UI KEYPAD BOARD	Would affect all buttons on front panel
	PRINTHEAD	Should print test pattern
	RECORDER BOARD	Drives the stepper motor and printhead
	RECORDER BOARD TO PRINTHEAD CABLE	Data to printhead
	RECORDER BOARD TO MAIN BOARD CABLE	
	RECORDER BOARD TO DOOR SWITCH CABLE	Will not print if main boards thinks door is open
	RECORDER MOTOR	Could have open winding or bad wire crimp in connector
	MAIN BOARD	Communicates with keypad
	SYSTEM POWER SUPPLY	
	DOOR SWITCH	Will not print if main boards thinks door is open
	DSP BOARD	Front panel keypad routed through DSP board
	FAN	Secondary failure due to overheating only
CHART LIGHT		
	UI KEYPAD BOARD	Would affect all buttons on front panel
	DSP TO UI KEYPAD CABLE	Affects all front panel functions
	SYSTEM POWER SUPPLY	
	MAIN BOARD	Communicates with keypad
	DSP BOARD	Front panel keypad routed through DSP board
	FAN	Secondary failure due to overheating only
ALARM SILENCE		
	DSP TO UI KEYPAD CABLE	Affects all front panel functions
	UI TO VOLUME BOARD CABLE	Affects Volume and Alarm Cancel
	VOLUME KEYPAD	Affects Volume and Alarm Cancel

250 SERIES SERVICE & TROUBLE SHOOTING		
PROBLEM	**SUBASSEMBLY**	**COMMENTS**
	SYSTEM POWER SUPPLY	
	MAIN BOARD	Communicates with Keypad
	DSP BOARD	Front Panel Keypad signals routed through DSP PWA
	FAN	Secondary cause from overheating
NIBP START/STOP		
	HOSES	■ To front panel, Pneumatics to main (blank) ■ Would affect all buttons on front panel ■ Could affect **NIBP Start/Stop** button (blank) ■ Can cause failures due to overheating ■ Would affect all buttons on front panel ■ Pump, valves, hoses ■ Affects all front panel functions ■ To front panel, Pneumatics to main
	DSP TO UI KEYPAD CABLE	Affects all front panel functions
	UI KEYPAD BOARD	Would affect all buttons on front panel
	PNEUMATICS BOARD (PUMP & VALVES)	Pump, valves, hoses
	MAIN BOARD	Communicates with keypad
	SYSTEM POWER SUPPLY	
	DSP BOARD	Front panel keypad routed through DSP board
	FAN	Secondary failure due to overheating only
MARK [OFFSET]		
	SYSTEM POWER SUPPLY	
	MAIN BOARD	Receives mark from rear panel
	FAN	Secondary failure due to overheating only
FAST		
	MAIN BOARD	Receives FAST signal from Rear Panel
	SYSTEM POWER SUPPLY	
	FAN	Secondary failure due to overheating only

250 SERIES SERVICE & TROUBLE SHOOTING		
PROBLEM	**SUBASSEMBLY**	**COMMENTS**
POWER ON		
	LINE CORD	
	SYSTEM POWER SUPPLY	
	POWER SWITCH CABLE	Bad contacts in connector or to switch
	POWER SWITCH	
	MAIN BOARD	Short circuit
	RECORDER BOARD	VHead Loading Power Supply
	FAN	Secondary failure due to overheating only.
	DSP BOARD	Loading Power Supply
PAPER OUT		
	RECORDER BOARD	Sensor Voltage Adjustment Drift
	RECORDER BOARD TO PAPER OUT SENSOR	
	RECORDER BOARD TO MAIN BOARD CABLE	
	MAIN BOARD	
	FAN	Secondary failure due to overheating only
PAPER MISLOAD		
	RECORDER BOARD TO PAPER MIS LOAD CABLE	
	RECORDER BOARD	Sensor Voltage Adjustment Drift
	RECORDER BOARD TO MAIN BOARD CABLE	
	MAIN BOARD	Processes this status from recorder board
	FAN	Secondary failure due to overheating only
PAPER JAM		
	RECORDER MOTOR	If motor or driver bad and does not have enough power
	RECORDER BOARD	

General Troubleshooting

Table 22. General Troubleshooting

Problem	Probable Cause	Possible Solution
No monitoring functions and green Power indicator does not illuminate when Power switch is placed in the On (I) position.	■ Monitor is not connected to an AC line connector. ■ The AC power cord is defective. ■ The AC outlet is defective. ■ The power cord is not connected to the monitor. ■ Blown fuses.	■ Connect the power cord to an AC line connector. ■ Replace the power cord. ■ Use a different outlet. ■ Connect the power cord to the monitor. ■ Call Biomedical Engineering Department.
■ Recorder does not function and the Record indicator is off.	■ Recorder is off, out of paper, or paper is incorrectly loaded.	■ Press **Record** button; or install/re-install paper (see "Loading Strip Chart Recorder Paper" on page 3-9), then press **Record** button.
■ Recorder does not function and the Record indicator flickers three short flashes every 5 seconds.	■ Recorder is in maternal-only mode.	■ Press **Record** button to turn on.
■ Recorder functions however, Record indicator flashes on and off every second.	■ Paper supply is low.	■ Install paper.
■ Recorder does not function; the Record indicator is off; the message *PAPER INCORRECTLY LOADED, RELOAD WITH BLACK SQUARES DOWN* is shown in maternal waveform area.	■ Paper loaded backwards.	■ Re-install paper.
■ Recorder does not function and the Record indicator is on.	■ Service required.	■ Call Biomedical Engineering Department.
Incorrect time and date.	■ Time incorrectly set. ■ Clock circuit or battery fault.	■ Access the *General Setup* screen and reset the time and date. ■ Call Biomedical Engineering Department.
No heartbeat or pulse sounds.	■ Volume set too low. ■ Transducer not connected or is loose.	■ Press the **Volume** buttons or access the respective setup screen(s) (*FECG, US,* or *US2*) to increase the volume. ■ Ensure that each transducer is securely attached to monitor and applied to the patient.

Ultrasound Troubleshooting

Table 23. Ultrasound Troubleshooting

Problem	Probable Cause	Possible Solution
Ultrasound not functioning properly.	■ Transducer not properly connected to monitor. ■ Transducer placement. ■ Too little gel applied to transducer. ■ Defective transducer. ■ Active fetus or mother. Fetal arrhythmia or hiccups. Extreme maternal obesity. ■ No signal. ■ Service required.	■ Ensure that transducer is securely attached to monitor. ■ Wait before moving transducer; FHR often returns. Reposition transducer. ■ Apply more gel. ■ Replace transducer. ■ Use alternate technique. ■ Auscultate FHR. ■ Call Biomedical Engineering Department.
Static noise on ultrasound.	■ Active fetus. ■ Environmental noise. ■ Maternal movement. ■ Defective transducer.	■ Reposition transducer. ■ Keep sheets and gown off transducer. Do not hold transducer with hand. ■ Use alternate monitoring mode. ■ Replace transducer.
Rate on FHR area of display and FHR trend on strip chart paper do not correlate.	■ Paper Scale is incorrectly configured to either *50-210 bpm* or *30-240 bpm.*	■ Call Biomedical Engineering Department.

FECG Troubleshooting

Table 24. FECG Troubleshooting

Problem	Probable Cause	Possible Solution
Internal FECG erratic or not recording properly.	■ Transducer not properly connected to monitor. ■ Attachment pad or legplate not securely attached to patient. ■ Electrode wire not secure in legplate post. ■ Paste is dried or incorrect paste is being used. ■ Electrode not properly attached. ■ No FECG signal. ■ Defective electrode. ■ Defective attachment pad. ■ Service required.	■ Ensure transducer is securely attached to the monitor. ■ Secure attachment pad or legplate to patient. ■ Inspect legplate connection. ■ Check ECG paste; re-apply, if necessary. ■ Replace electrode. ■ Auscultate FHR. ■ Replace electrode. ■ Replace attachment pad. ■ Call Biomedical Engineering Department.
Rate in FHR area of the display and the FHR trend on the strip chart paper do not correlate.	■ Paper Scale is incorrectly configured to either 50-210 bpm or 30-240 bpm.	■ Call Biomedical Engineering Department.

External Uterine Activity Troubleshooting

Table 25. External UA Troubleshooting

Problem	Probable Cause	Possible Solution
Tocotransducer not recording contractions.	■ Transducer not properly connected to monitor. ■ Transducer not properly placed. ■ Transducer not secured to patient. ■ Defective transducer/cable assembly. ■ No maternal contractions. ■ UA Reference range exceeded.	■ Ensure that transducer is securely attached to monitor. ■ Reposition transducer. ■ Secure or re-apply transducer to patient. ■ Replace transducer/cable assembly. ■ Wait. ■ Loosen belts or remove transducer from patient. Press **UA Reference** button while no pressure is applied to transducer button. Re-apply transducer. Do not overtighten belt. Press **UA Reference** button again between contractions.
Flashing "+" sign.	■ Relative pressure > 100.	■ Press the **UA Reference** button between contractions.
CHECK TOCO message is shown in UA area of the display area when the **UA Reference** button is pressed.	■ **UA Reference** button pressed before UA circuits stabilized. ■ UA Reference range exceeded due to over-tightening belt. ■ Transducer defective. ■ Service required.	■ You must wait ten seconds following powering on the monitor and/or connecting to the **UA** connector. ■ Loosen belts or remove transducer from patient. Press **UA Reference** button while no pressure is applied to transducer button. Re-apply transducer. Do not overtighten belt. Press **UA Reference** button again between contractions. ■ Replace transducer. ■ Call Biomedical Engineering Department.

Internal UA Troubleshooting

Table 26. Internal UA Troubleshooting

Problem	Probable Cause	Possible Solution
Internal pressure not measuring correctly.	■ Transducer not properly connected to monitor. ■ Air bubble in dome; or catheter blocked. ■ Dome is cracked. ■ Strain gauge not at same height as catheter tip. ■ Catheter has fallen out of place. ■ Catheter or strain gauge not zeroed. ■ Service required.	■ Ensure transducer is securely attached to monitor. ■ Flush dome and catheter. ■ Replace dome. ■ Adjust strain gauge height. ■ Replace catheter. ■ Calibrate catheter or strain gauge. ■ Call Biomedical Engineering Department.
CHECK IUP message displayed in UA area of the display.	■ Blockage in fluid-filled catheter. ■ Fetus pressing directly on catheter. ■ Defective strain gauge or catheter. ■ Service required.	■ Flush catheter. Re-zero. Replace catheter if necessary. ■ Reposition by twisting catheter. ■ Replace strain gauge or catheter. ■ Call Biomedical Engineering Department.

MECG Troubleshooting

Table 27. MECG Troubleshooting

Problem	Probable cause	Possible solution
MECG erratic or not functioning properly.	■ Patient cable not properly connected to monitor. ■ Electrodes not properly placed. ■ Clips not attached to electrodes properly. ■ Electrode gel dried. ■ Defective MECG cable. ■ Service required. ■ Selected lead providing inadequate signal.	■ Ensure patient cable is securely attached to monitor. ■ Re-apply electrodes. ■ Check clip attachments. ■ Check electrodes and re-apply gel if necessary. ■ Replace cable. ■ Call Biomedical Engineering Department. ■ Change lead selection on MHR/P Setup screen.
Dashes (– – –) shown in MHR/P area of display.	■ Monitor unable to make a determination due to insufficient signal.	■ Ensure patient is not asystolic. ■ Ensure electrodes are firmly secured to patient.

Blood Pressure Troubleshooting

Table 28. Blood Pressure Troubleshooting

Problem	Probable Cause	Possible Solution
High reading.	■ Measurement taken during uterine contraction.	■ Annotate chart, then take a manual reading in-between contractions. ■ If possible, cancel reading during contraction. ■ Enable the monitor's *Smart BP* feature.
CHECK CUFF message displayed in NIBP area of display.	■ Improper cuff position. ■ Loose cuff. ■ Air pressure error. ■ Maternal movement. ■ Hose not properly connected to monitor. ■ Neonatal cuff connected.	■ Reposition cuff. ■ Tighten cuff. ■ Contact Biomedical Engineering Department. ■ Restrict patient limb movement. ■ Ensure that hose is firmly attached to monitor. ■ Ensure an adult cuff is connected.
OVERPRESSURE message displayed in NIBP area of display.	■ Cuff pressure has exceeded the overpressure limit of 315 mmHg. ± 15 mmHg. ■ Kinked hose. ■ Blocked hose.	■ Restrict patient limb movement. If this is not the case, contact Biomedical Engineering Department. ■ Check the external cuff for kinks. ■ Perform pneumatic test.
COMM message displayed in *NIBP* area of display.	■ Communication error between the built-in NIBP module and the remainder of the monitor circuitry.	■ Call Biomedical Engineering Department.
MOTION message displayed in *NIBP* area of display.	■ Excessive maternal movement.	■ Restrict patient limb movement. Restrain limb if necessary. ■ Talk to patient about the importance of minimizing limb movement.
Dashes (– – –) displayed in *NIBP* area of display.	■ Unable to determine blood pressure.	■ Reposition cuff ■ Check patient for arrhythmia. Move cuff to another limb.
REPAIR message display in *NIBP* area of display.	■ System error or self-test failure.	■ Contact Biomedical Engineering Department.
WEAK SIGNAL message	■ Monitor unable to make a determination due to insufficient signal.	■ Assess patient situation.

Maternal Pulse Oximetry Troubleshooting

Table 29. Maternal Pulse Oximetry Troubleshooting

Problem	Probable Cause	Possible Solution
COMM message shown in *MSpO$_2$* area of display.	■ Communication error between the built-in MSpO$_2$ module and the remainder of the monitor circuitry.	■ Contact Biomedical Engineering Department.
Dashes (– – –) shown in *MSpO$_2$* display area.	■ Monitor unable to make a determination due to insufficient signal.	■ Check patient. The patient may be experiencing shock, hypotension, severe vasoconstriction, severe anemia, hypothermia, arterial occlusion proximal to the sensor, or cardiac arrest. ■ Ensure that the intermediate cable is firmly attached to the monitor and to the sensor assembly.
	■ Improperly applied sensor.	■ Ensure sensor is not too tight. Move sensor to another location.
	■ Excessive maternal movement.	■ Restrict patient limb movement. Restrain limb if necessary.
	■ Excessive ambient light.	■ Cover sensor with opaque material.
	■ Damaged sensor	■ Replace sensor.
MHR/P Pulse source is blank when *MSpO$_2$* is selected	■ Normal mode selected	■ Select Fast mode on *MSpO$_2$ Setup* screen.
REPAIR message shown in *MSpO$_2$* area of display. (Nellcor only)	■ System error or self-test failure.	■ Contact Biomedical Engineering Department.

Error Log Screen

6 Parts List, Drawings, and Replacement

For your notes

Ordering Parts

This section of the manual provides parts lists for the 250 Series Monitor. Parts lists should be used in conjunction with the other chapters of this manual.

GE makes every effort possible to provide the most up-to-date reference documentation for your equipment. However, in special cases involving field-installed upgrades, the revision level of a diagram or parts list in this manual may not reflect the revision level of your unit's subassemblies. When discrepancies are found, contact your GE Medical Systems *Information Technologies* Service Representative.

NOTE: Fab drawings are not contained in this manual.

Service Parts

WARNING
REPAIR TO THE FRU LEVEL - Field repairs are recommended to the field replaceable unit (FRU) only. Attempting a field repair on a PCB or a factory sealed component or assembly could jeopardize the safe and effective operation of the monitor.

Field-Replaceable Units (FRUs)

FRU List

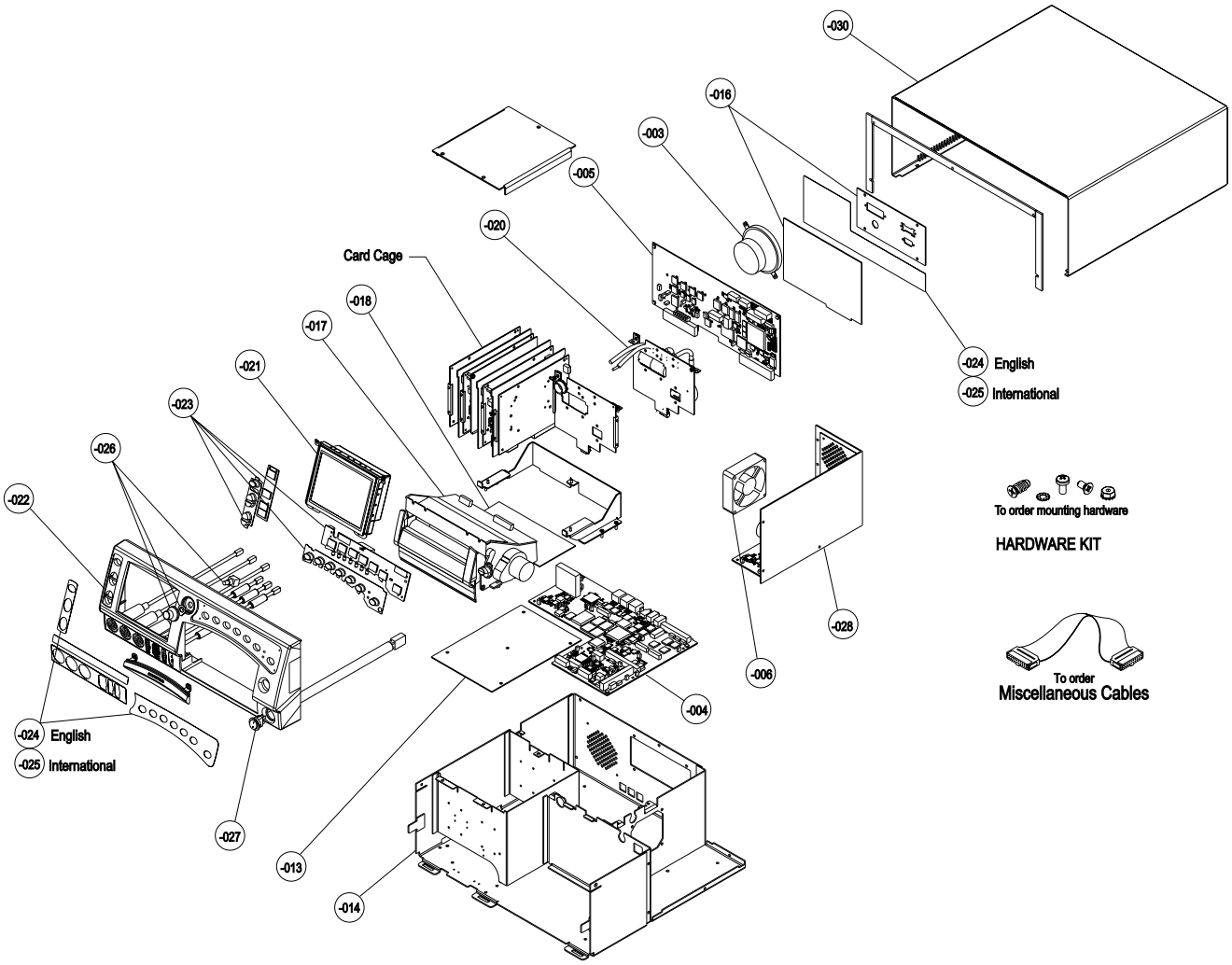
The following table offers details of each of the corresponding bubble numbers that appear on the exploded engineering-assembly drawings (tri-folded drawings at the end of this section).

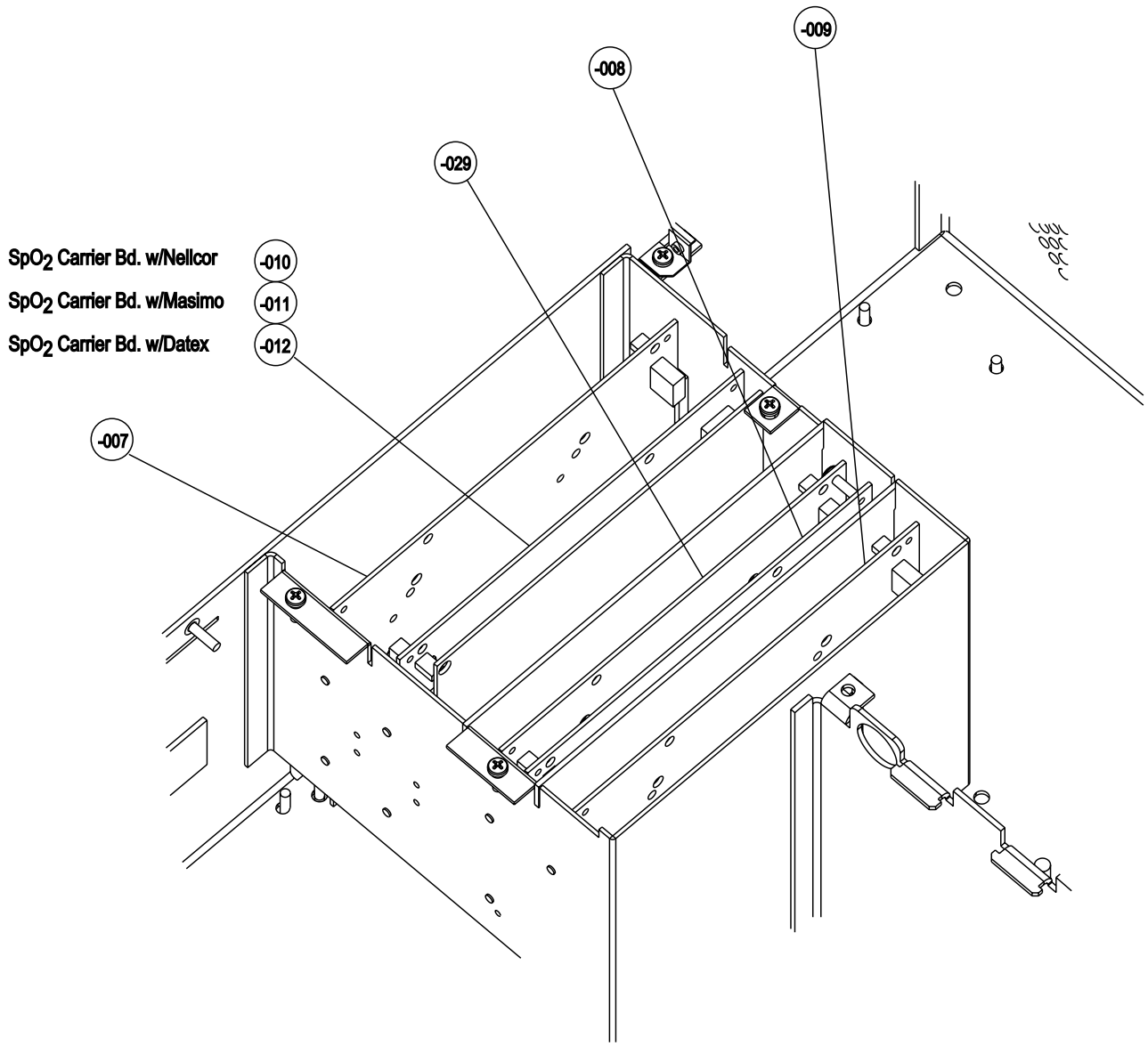
Serv. Manual Drawing Page Number	Bubble Number	Part Number	Description	Comments
1	2-5,7-11	2025177-024	Front/Rear Panel Labels FRU (Eng)	
1	2-5,7-11	2025177-025	Front/Rear Panel Labels FRU (INT)	
1	1	2025177-030	Top Cover FRU	
3	N/A	2025177-019	Misc Cable FRU	Does not include front end patient cables
4	N/A	2025177-003	Speaker FRU	
4	3	2025177-005	DSP Board FRU	
4	6	2025177-007	Dual Ultrasound Board FRU	
4	7	2025177-008	FECG/UA w/MECG Board FRU	
4	7	2025177-009	Isolated Power Supply Board FRU	
4	9	2025177-010	SpO_2 Carrier Board w/Nellcor Ox FRU	
4	9	2025177-011	SpO_2 Carrier Board w/Masimo Ox FRU	
4	9	2025177-012	SpO_2 carrier Board w/Ohmeda Ox FRU	
4	N/A	2025177-020	Pneumatics Board FRU	
4	2	2025177-029	MECG Board FRU	
5	5	2025177-006	Fan FRU	
5	3	2025177-013	Front-end Mother Board. FRU	
5	4	2025177-016	Comm Board w/plate FRU	
5	2	2025177-028	Main Power Supply FRU	
6	4	2025177-004	Main Board FRU	
6	10	2025177-014	Chassis Assembly DRU	Depot repair only, do not ship to FE. Customers out of warranty may purchase
7	28	2025177-027	Power Switch Assembly	
9	26	2025177-021	Display FRU	

Serv. Manual Drawing Page Number	Bubble Number	Part Number	Description	Comments
9	1	2025177-022	Plastic Bezel w/cables DRU	Depot repair only, do not ship to FE. Customers out of warranty may purchase
9	2-4	2025177-023	Keypad/Volume Pad FRU	
9	7,8	2025177-026	Trim Knob and Switch	
10	1	2025177-017	Recorder Assembly w/o Mnt Brkt FRU	
11	25	2025177-018	Recorder Board FRU	
N/A	N/A	2025177-002	Hardware Kit FRU	Screws, washers, spacers for full monitor
N/A	N/A	2025177-031	Top Cover Gasket FRU	Refer to Caution on page 6-30

FRU Main Reference Guide Drawing

For quick reference use the following FRU Main Reference Guide drawing. The numbers in the bubbles coincide with the last three digits of the part number listed in the FRU list (e.g., -020 represents FRU P/N 2025177-020).




-009
-008
-029
SpO2 Carrier Bd. w/Nellcor
-010
SpO2 Carrier Bd. w/Masimo
-011
SpO2 Carrier Bd. w/Datex
-012
-007

Assembly/Disassembly of FRUs

2025177-003 Speaker

1. Remove top cover. Keep screws aside.
2. Disconnect speaker cable from Main board connector J10.
3. Remove nuts and flat washers fixing Speaker to mounting posts. Keep nuts and washers aside.
4. Remove old Speaker from mounting posts. Keep existing nylon washers on mounting posts.
5. Place new Speaker onto mounting posts on top of nylon washers.
6. Replace nuts and flat washers onto mounting posts over new Speaker.
7. Connect Speaker cable to Main board connector J10.
8. Replace top cover. Re-insert screws.

2025177-004 Main Board

1. Remove top cover. Keep screws aside.
2. Disconnect 8-conductor Inverter cable from DSP board connector J1.
3. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
4. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
5. Remove two screws fixing DSP board to chassis. Keep screws aside.
6. Remove DSP board from Main board.
7. Remove two screws fastening Pneumatics assembly to chassis.
8. Remove Pneumatics assembly. Leave tubing connected to Front Bezel. The tubing length should be sufficient.
9. Disconnect power supply cable from Main board connector J8.
10. Disconnect speaker cable from Main board connector J10.
11. Remove four screws fastening the Comm. Board to the chassis.
12. Remove Comm. board from Main board.
13. Remove six screws that fasten Main board to chassis.
14. Remove Main board from chassis.
15. Remove nuts from Main board PH1, 2, & 3 connectors that fasten EMI Plate to Main board.
16. Place EMI Plate and Gasket onto new Main board. Use nuts from Main board PH1, 2, & 3 connectors to fix Plate to Main board.
17. Place Main board onto chassis. Use six screws to fasten Main board to chassis.

18. Connect speaker cable to Main board connector J10.
19. Place Comm. board onto Main board.
20. Fasten Comm. board onto chassis with four screws.
21. Connect power supply cable to Main board connector J8.
22. Replace Pneumatics assembly onto Main board.
23. Connect clear section of tubing from E1 to PT1 on Main board.
24. Connect clear section of tubing from E2 to PT2 on Main board.
25. Fasten Pneumatics assembly to chassis with two screws.
26. Connect printer cable to Main board connector J9.
27. Connect 8-conductor Inverter cable to DSP board connector J1.
28. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
29. Connect 10-conductor DSP-to-Keypad ribbon cable to DSP board connector J5.
30. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
31. Replace top cover. Re-insert screws.

2025177-005 DSP Board

1. Remove top cover. Keep screws aside.
2. Disconnect 8-conductor Inverter cable from DSP board connector J1.
3. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
4. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
5. Remove two screws fastening DSP board to chassis. Keep screws aside.
6. Remove DSP board from Main board.
7. Connect 8-conductor Inverter cable to DSP board connector J1.
8. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
9. Connect 10-conductor DSP-to-Keypad ribbon cable to DSP board connector J5.
10. Place new DSP board onto Main board.
11. Reuse two screws to fasten DSP board to chassis.
12. Replace top cover. Re-insert screws.

2025177-006 Main Power Supply

1. Remove top cover. Keep screws aside.
2. Cut tie-wrap holding power-switch cable to cable-tie mount on chassis.

3. Disconnect power-switch cable from front-bezel power-switch chassis-mounted connector.
4. Remove cable-tie mount from side of chassis.
5. Disconnect Power Supply cable from J1 connector on Recorder board.
6. Disconnect Power Supply cable from J8 connector on Main board.
7. Remove three flat-head screws from side of Power Supply.
8. Remove four pan-head screws from back of Power Supply.
9. Remove one pan-head screw from inside bottom of Power Supply.
10. Remove Power Supply from chassis.
11. Replace with new Power Supply.
12. Fasten three flat-head screws into side of Power Supply.
13. Fasten four pan-head screws into back of Power Supply.
14. Fasten one pan-head screw into inside bottom of Power Supply.
15. Connect Power Supply cable to J1 connector on Recorder board.
16. Connect Power Supply cable to J8 connector on Main board.
17. Connect power-switch cable to front-bezel power-switch chassis-mounted connector.
18. Adhere new cable tie mount to side of chassis.
19. Use tie-wrap to fasten power-switch cable to cable-tie mount on chassis.
20. Replace top cover. Re-insert screws.
21. Set the voltage selector switch (located on the rear panel) to the appropriate voltage.

2025177-007 Dual Ultrasound Board

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board, but do not fully remove from chassis.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Remove card cage cover. Keep screws aside.
7. Disconnect Ultrasound cables from Ultrasound board connectors.
8. Remove Ultrasound board from Front-end Motherboard.
9. Insert new Ultrasound board into Front-end Motherboard.
10. Reconnect Ultrasound cables to Ultrasound board connectors. The left-most Ultrasound connector US1 cable goes to the rear connector on Ultrasound board, J5.
11. Replace card cage cover. Re-insert screws.

12. Connect 8-conductor Inverter cable to DSP board connector J1.
13. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
14. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
15. Place top cover. Re-insert screws.

2025177-008 FECG/UA Board

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis. Keep screws aside.
3. Remove DSP board from Main board, but do not fully remove from chassis.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Remove card cage cover. Keep screws aside.
7. **(If MECG is installed)** Disconnect MECG cable from MECG board connector.
8. Remove MECG **(if installed)** and FECG board from Front-end Motherboard.
9. **(If MECG is installed)** Remove two screws fastening MECG board to FECG board.
10. **(If MECG is installed)** Remove MECG board from FECG board.
11. **(If MECG is installed)** Insert MECG board onto new FECG board and fasten with two screws.
12. Insert MECG **(if installed)** and new FECG board into Front-End Motherboard.
13. **(If MECG is installed)** Connect MECG cable to MECG board connector.
14. Replace card cage cover. Re-insert screws.
15. Reconnect 8-conductor Inverter cable to DSP board connector J1.
16. Reconnect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
17. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
18. Place top cover. Re-insert screws.

2025177-009 Isolated Power Supply Board

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.

6. Remove card cage cover. Keep screws aside.
7. Remove Isolated Power Supply board from Front-end Motherboard.
8. Insert new Isolated Power Supply board into Front-End Motherboard.
9. Replace card cage cover. Re-insert screws.
10. Reconnect 8-conductor Inverter cable to DSP board connector J1.
11. Reconnect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
12. Place DSP board onto board. Use two screws to fasten DSP board to chassis.
13. Place top cover. Re-insert screws.

2025177-010 SpO_2 Carrier Board with Nellcor $MSpO_2$ Module

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Remove card cage cover. Keep screws aside.
7. Disconnect $MSpO_2$ cable from SpO_2 Carrier board connector.
8. Remove SpO_2 Carrier board with Nellcor $MSpO_2$ Module assembly from Front-end Motherboard.
9. Insert new SpO_2 Carrier board with Nellcor $MSpO_2$ Module assembly into Front-End Motherboard.
10. Reconnect $MSpO_2$ cable to SpO_2 Carrier board connector J10.
11. Replace card cage cover. Re-insert screws.
12. Reconnect 8-conductor Inverter cable to DSP board connector J1.
13. Reconnect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
14. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
15. Place top cover. Re-insert screws.

2025177-011 SpO_2 Carrier Board with Masimo $MSpO_2$ Module

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.

5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Remove card cage cover. Keep screws aside.
7. Disconnect $MSpO_2$ cable from SpO_2 Carrier board connector.
8. Remove SpO_2 Carrier board with Masimo $MSpO_2$ Module assembly from Front-end Motherboard.
9. Insert new SpO_2 Carrier board with Masimo $MSpO_2$ Module assembly into Front-End Motherboard.
10. Reconnect $MSpO_2$ cable to SpO_2 Carrier board connector J10.
11. Replace card cage cover. Re-insert screws.
12. Reconnect 8-conductor Inverter cable to DSP board connector J1.
13. Reconnect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
14. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
15. Place top cover. Re-insert screws.

2025177-012 SpO_2 Carrier Board with TruSignal $MSpO_2$ Module

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Remove card cage cover. Keep screws aside.
7. Disconnect $MSpO_2$ cable from SpO_2 Carrier board connector.
8. Remove SpO_2 Carrier board with TruSignal $MSpO_2$ Module assembly from Front-end Motherboard.
9. Insert new SpO_2 Carrier board with TruSignal $MSpO_2$ Module assembly into Front-End Motherboard.
10. Reconnect $MSpO_2$ cable to SpO_2 Carrier board connector J10.
11. Replace card cage cover. Re-insert screws.
12. Reconnect 8-conductor Inverter cable to DSP board connector J1.
13. Reconnect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
14. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
15. Place top cover. Re-insert screws.

2025177-013 Front-end Motherboard

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Remove card cage cover. Keep screws aside.
7. Disconnect Ultrasound cables from Ultrasound board connectors.
8. Remove Ultrasound board from Front-end Motherboard.
9. Disconnect MSpO_2 cable from SpO_2 Carrier board connector.
10. Remove SpO_2 Carrier board assembly from Front-end Motherboard.
11. Disconnect MECG cable from MECG board connector.
12. Remove MECG/FECG board assembly from Front-end Motherboard.
13. Remove Isolated Power Supply board from Front-end Motherboard.
14. Remove three insulating metal sheets from Front-end Motherboard.
15. Remove five screws fastening the Front-end Motherboard to the chassis.
16. Remove two screws on both sides of monitor fastening the front bezel to the chassis.
17. Tilt the front bezel forward, away from the chassis.
18. Remove MSpO_2 cable beads from chassis bead clips.
19. Remove MECG and FECG cable beads from chassis bead clips.
20. Remove FECG ground cable from chassis post by removing nut.
21. Disconnect FECG cable from Front-end Motherboard.
22. Disconnect IUP cable from Front-end Motherboard.
23. Remove Front-end Motherboard.
24. Slide new Front-end Motherboard under card cage onto chassis.
25. Fasten to chassis with five screws.
26. Connect IUP cable to Front-end Motherboard.
27. Connect FECG cable to Front-end Motherboard.
28. Place FECG ground cable onto chassis post and tighten with nut.
29. Insert MECG and FECG cable beads into chassis bead clips.
30. Insert MSpO_2 cable beads into chassis bead clips.
31. Insert three insulating metal sheets onto Front-end Motherboard.
32. Insert Isolated Power Supply board onto Front-end Motherboard.
33. Insert MECG/FECG board assembly onto Front-end Motherboard.

34. Connect MECG cable to MECG board connector.
35. Insert SpO_2 Carrier board assembly onto Front-end Motherboard.
36. Connect $MSpO_2$ cable to SpO_2 Carrier board connector.
37. Insert Ultrasound board onto Front-end Motherboard.
38. Connect Ultrasound cables to Ultrasound board connectors. The left-most Ultrasound connector US1 cable goes to the rear connector on Ultrasound board, J5.
39. Replace card cage cover. Re-insert screws.
40. Connect 8-conductor Inverter cable to DSP board connector J1.
41. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
42. Place DSP board onto board. Use two screws to fasten DSP board to chassis.
43. Place top cover. Re-insert screws.

2025177-014 Chassis

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis. Keep screws aside.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
7. Remove one flat-head screw from each side of the monitor fastening the front bezel to chassis.
8. Open Recorder door, as it will interfere with front bezel movement.
9. Tilt the front bezel forward, away from the chassis.
10. Remove card cage cover. Keep screws aside.
11. Disconnect Ultrasound cables from Ultrasound board connectors.
12. Disconnect $MSpO_2$ cable from SpO_2 Carrier board connector.
13. Disconnect MECG cable from MECG board connector.
14. Remove $MSpO_2$ cable beads from chassis bead clips.
15. Remove MECG and FECG cable beads from chassis bead clips.
16. Remove FECG ground cable from chassis post by removing nut.
17. Disconnect FECG cable from Front-end Motherboard.
18. Disconnect IUP cable from Front-end Motherboard.
19. Disconnect two red Pneumatics tubes from Front-bezel NIBP connector.

20. Pull red tubes through chassis grommet away from Front-bezel.
21. Disconnect orange connector receptacle of power switch cable assembly from orange chassis-mounted plug.
22. Remove front bezel from chassis tabs.
23. Remove Ultrasound board from Front-end Motherboard. Remove SpO_2 Carrier board assembly from Front-end Motherboard.
24. Remove MECG/FECG board assembly from Front-end Motherboard.
25. Remove Isolated Power Supply board from Front-end Motherboard.
26. Remove three insulating metal sheets from Front-end Motherboard.
27. Remove five screws fastening the Front-end Motherboard to the chassis.
28. Remove Front-end Motherboard.
29. Disconnect 20-conductor Recorder ribbon cable from Main board connector J9.
30. Disconnect power supply cable from J1 connector on Recorder board.
31. Disconnect Recorder EMC ground wire Fast-on tab from chassis.
32. Remove four screws fastening Recorder assembly mounting bracket to chassis.
33. Remove Recorder assembly and mounting bracket.
34. Remove two screws fastening Pneumatics assembly to chassis.
35. Disconnect clear tubing from both PT1 and PT2 on the Main board.
36. Remove Pneumatics assembly from the Main board.
37. Remove four screws fastening the Comm. Board to the chassis.
38. Remove Comm. board from Main board.
39. Disconnect power supply cable from Main board connector J8.
40. Disconnect speaker cable from Main board connector J10.
41. Remove six screws that fasten Main board to chassis.
42. Remove Main board with EMI plate from chassis.
43. Cut tie-wrap holding power-switch cable to cable-tie mount on chassis.
44. Remove power supply chassis-mounted connector from chassis.
45. Remove cable-tie mount from side of chassis.
46. Disconnect Power Supply cable from J1 connector on Recorder board.
47. Disconnect Power Supply cable from J8 connector on Main board.
48. Remove three flat-head screws from side of Power Supply.
49. Remove four pan-head screws from back of Power Supply.
50. Remove one pan-head screw from inside bottom of Power Supply.
51. Remove Power Supply from chassis.
52. Replace chassis assembly with new chassis assembly.
53. Place Power Supply onto chassis.
54. Fasten three flat-head screws into side of Power Supply.

55. Fasten four pan-head screws into back of Power Supply.
56. Fasten one pan-head screw into inside bottom of Power Supply.
57. Insert power supply power-switch connector into chassis.
58. Adhere new cable tie mount to side of chassis.
59. Use tie-wrap to fasten power-switch cable to cable-tie mount on chassis.
60. Place Main board with EMI plate onto chassis. Use six screws to fasten Main board to chassis.
61. Connect speaker cable to Main board connector J10.
62. Connect power supply cable to Main board connector J8.
63. Place Comm. board onto Main board.
64. Fasten Comm. board onto chassis with four screws.
65. Place new Pneumatics assembly onto Main board
66. Insert two screws fastening Pneumatics assembly onto chassis.
67. Connect clear section of tubing from E1 to PT1 on Main board.
68. Connect clear section of tubing from E2 to PT2 on Main board.
69. Pull red tubes through chassis grommet towards Front-bezel.
70. Fasten Recorder assembly and mounting bracket to chassis with four M3.5x6 screws.
71. Connect Recorder EMC ground wire Fast-on tab to chassis.
72. Connect power supply cable to J1 connector on Recorder board.
73. Connect 20-conductor Recorder ribbon cable to Main board connector J9.
74. Slide new Front-end Motherboard under card cage onto chassis.
75. Fasten to chassis with five screws.
76. Insert three insulating metal sheets onto Front-end Motherboard.
77. Insert Isolated Power Supply board onto Front-end Motherboard.
78. Insert MECG/FECG board assembly onto Front-end Motherboard.
79. Insert SpO_2 Carrier board assembly onto Front-end Motherboard.
80. Insert Ultrasound board onto Front-end Motherboard.
81. Insert front bezel into chassis tabs.
82. Connect orange connector receptacle of new power switch cable to orange chassis-mounted plug.
83. Pull red tubes through chassis grommet towards Front-bezel.
84. Connect red tubes to Front-bezel NIBP connector.
85. Connect IUP cable to Front-end Motherboard.
86. Connect FECG cable to Front-end Motherboard.
87. Place FECG ground cable onto chassis post and tighten with nut.
88. Insert MECG and FECG cable beads into chassis bead clips.

89. Insert $MSpO_2$ cable beads into chassis bead clips.
90. Connect MECG cable to MECG board connector.
91. Connect $MSpO_2$ cable to SpO_2 Carrier board connector.
92. Connect Ultrasound cables to Ultrasound board connectors. The left- most Ultrasound connector US1 cable goes to the rear connector on Ultrasound board, J5.
93. Replace card cage cover. Re-insert screws.
94. Tilt the front bezel back onto chassis. Refasten screws to each side of chassis.
95. Connect 10-conductor DSP-to-UI Keypad ribbon cable to DSP board connector J5.
96. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
97. Connect 8-conductor Inverter cable to DSP board connector J1.
98. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
99. Slide-on top cover. Re-insert screws.

2025177-016 COMM Board

1. Remove top cover. Keep screws aside.
2. Remove four screws fastening the Comm. Board to the chassis.
3. Remove Comm. board from Main board.
4. Place new Comm. board onto Main board.
5. Fasten Comm. board onto chassis with four screws.
6. Replace top cover. Re-insert screws.

2025177-017 Recorder Assembly

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
7. Remove one flat-head screw from each side of the monitor fastening the front bezel to chassis.
8. Open Recorder door, as it will interfere with front bezel removal.
9. Tilt the front bezel forward, away from the chassis.

10. Disconnect 20-conductor Recorder ribbon cable from Recorder board connector J2.
11. Disconnect power supply cable from J1 connector on Recorder board.
12. Disconnect Recorder EMC ground wire Fast-on connector from chassis tab.
13. Remove four screws fastening Recorder assembly mounting bracket to chassis.
14. Remove Recorder assembly and mounting bracket. Do not snag bracket on hoses or cables while removing.
15. Flip over the Recorder assembly. Remove three screws fastening Recorder assembly to mounting bracket.

Installing new Recorder Assembly:

1. Fasten new Recorder assembly to mounting bracket with three screws.
2. Fasten Recorder assembly and mounting bracket to chassis with four screws. Do not fully tighten four screws, as you will need to adjust later in the procedure.
3. Connect Recorder EMC ground wire Fast-on connector to chassis tab.
4. Connect power supply cable to J1 connector on Recorder board.
5. Connect 20-conductor Recorder ribbon cable to Recorder board connector J2.
6. Open Recorder door, as it will interfere with front bezel attachment.
7. Tilt the front bezel back onto chassis. Ensure that two front bezel fiducial pins are aligned with Recorder slots. Ensure that three tabs on the bottom of front bezel are aligned with chassis slots. (See photograph below.)
8. Refasten screws to each side of chassis.
9. Close Recorder door.
10. Align the Recorder so that it is equidistant from both sides of the printer opening in the front bezel and the Recorder door is flush with the outside of the front bezel.
11. Check that door will open and close without interference.
12. Connect 10-conductor DSP-to-Keypad ribbon cable to DSP board connector J5.
13. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
14. Connect 8-conductor Inverter cable to DSP board connector J1.
15. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
16. Slide-on top cover. Re-insert screws.

2025177-018 Recorder Board

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.

3. Remove DSP board from Main board.
4. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
5. Disconnect 20-conductor Recorder ribbon cable from Recorder board connector J2.
6. Disconnect power supply cable from J1 connector on Recorder board.
7. Disconnect Recorder EMC ground wire Fast-on connector from chassis tab.
8. Disconnect two Recorder optical sensor cables from Recorder board connectors J5 and J6.
9. Disconnect Recorder paper orientation sensor cable from Recorder board connector J8.
10. Disconnect Recorder print head cable from Recorder board connector J3.
11. Remove one screw fastening Recorder board to Recorder assembly.
12. Remove Recorder board

Installing new Recorder Board:

1. Fasten new Recorder board to Recorder assembly with one screw.
2. Connect Recorder print head cable to Recorder board connector J3.
3. Connect Recorder paper orientation sensor cable to Recorder board connector J8.
4. Connect two Recorder optical sensor cables to Recorder board connectors J5 and J6.
5. Connect Recorder EMC ground wire Fast-on connector to chassis tab.
6. Connect power supply cable to J1 connector on Recorder board.
7. Connect 20-conductor Recorder ribbon cable to Recorder board connector J2.
8. Open Recorder door, as it will interfere with front bezel attachment.
9. Tilt the front bezel back onto chassis.
10. Refasten screws to each side of chassis.
11. Close Recorder door.
12. Connect 10-conductor DSP-to-Keypad ribbon cable to DSP board connector J5.
13. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
14. Connect 8-conductor Inverter cable to DSP board connector J1.
15. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
16. Slide-on top cover. Re-insert screws.

2025177-019 Cables

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
7. Remove one flat-head screw from each side of the monitor fastening the front bezel to chassis.
8. Open Recorder door, as it will interfere with front bezel movement.
9. Tilt the front bezel forward, away from the chassis.
10. Disconnect 10-conductor Keypad-to-Volume ribbon cable from Volume board connector.
11. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from the opening in the back of the Display assembly.
12. Connect replacement cable to LCD Decoder board through Display assembly opening. Use either end of the cable. The connector is keyed and will only mate the correct way.
13. Using needle-nose pliers, disconnect 8-conductor Inverter cable from the opening in the side of the Display assembly.
14. Connect replacement cable to Inverter board through Display assembly opening. Use either end of the cable. The connector is keyed and will only mate the correct way.
15. Disconnect 10-conductor Keypad-to-Volume ribbon cable from Keypad board connector J7.
16. Connect replacement cable to J7. Use end of the cable without the fold.
17. Remove two screws fastening Keypad bracket to front bezel.
18. Remove Keypad bracket.
19. Disconnect 10-conductor DSP-to-Keypad ribbon cable from Keypad board connector J5. Connect replacement cable to J5. Use either end of the cable. The connector is keyed and will only mate the correct way.
20. Fasten Keypad bracket to front bezel with two screws.
21. Connect 10-conductor Keypad-to-Volume ribbon cable to Volume board connector.
22. Tilt the front bezel back onto chassis. Refasten screws to each side of chassis.
23. Connect 10-conductor DSP-to-Keypad ribbon cable to DSP board connector J5.
24. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.

25. Connect 8-conductor Inverter cable to DSP board connector J1.
26. Slide-on top cover. Re-insert screws.

2025177-020 Pneumatics Assembly

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Disconnect 10-conductor DSP-to- Keypad ribbon cable from DSP board connector J5.
7. Disconnect 20-conductor Recorder ribbon cable from Main board connector J9.
8. Remove two screws on both sides of monitor fastening the front bezel to the chassis.
9. Tilt the front bezel forward, away from the chassis.
10. Disconnect two red Pneumatics tubes from Front-bezel NIBP connector.
11. Pull red tubes through chassis grommet away from Front-bezel.
12. Remove two screws fastening Pneumatics assembly to chassis. Keep screws aside.
13. Disconnect clear tubing from both PT1 and PT2 on the Main board.
14. Remove Pneumatics assembly from the Main board.
15. Replace new Pneumatics assembly onto Main board
16. Replace two screws fixing Pneumatics assembly onto chassis.
17. Connect clear section of tubing from E1 to PT1 on Main board.
18. Connect clear section of tubing from E2 to PT2 on Main board.
19. Pull red tubes through chassis grommet towards Front-bezel.
20. Connect red tubes to Front-bezel NIBP connector.
21. Connect 20-conductor Recorder ribbon cable to Main board connector J9.
22. Tilt the front bezel back onto chassis. Refasten screws to each side of chassis.
23. Connect 10-conductor DSP-to-UI Keypad ribbon cable to DSP board connector J5.
24. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
25. Connect 8-conductor Inverter cable to DSP board connector J1.
26. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
27. Replace top cover. Re-insert screws.

2025177-021 Display Assembly

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
7. Remove one flat-head screw from each side of the monitor fastening the front bezel to chassis.
8. Open Recorder door, as it will interfere with front bezel movement.
9. Tilt the front bezel forward, away from the chassis.
10. Disconnect 10-conductor Keypad-to-Volume ribbon cable from Volume board connector.
11. Remove screw fastening Display mounting bracket to front bezel.
12. Remove screw fastening bracket to Display assembly.
13. Remove four screws fastening Display assembly to front bezel.
14. Remove Display assembly.
15. Remove Display lens.
16. Insert new Display lens.
17. Insert new Display assembly. Fasten to front bezel with screws.
18. Fasten bracket to Display assembly with screw.
19. Fasten bracket to front bezel with screw.
20. Connect 10-conductor Keypad-to-Volume ribbon cable to Volume board connector.
21. Tilt the front bezel back onto chassis. Refasten screws to each side of chassis.
22. Connect 10-conductor DSP-to-Keypad ribbon cable to DSP board connector J5.
23. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
24. Connect 8-conductor Inverter cable to DSP board connector J1.
25. Slide-on top cover. Re-insert screws.

2025177-022 Front Bezel

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis. Keep screws aside.
3. Remove DSP board from Main board, but do not fully remove from chassis.

4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
7. Remove one flat-head screw from each side of the monitor fastening the front bezel to chassis.
8. Tilt the front bezel forward, away from the chassis.
9. Remove card cage cover. Keep screws aside.
10. Disconnect Ultrasound cables from Ultrasound board connectors.
11. Disconnect $MSpO_2$ cable from SpO_2 Carrier board connector.
12. Disconnect MECG cable from MECG board connector.
13. Remove $MSpO_2$ cable beads from chassis bead clips.
14. Remove MECG and FECG cable beads from chassis bead clips.
15. Remove FECG ground cable from chassis post by removing nut.
16. Disconnect FECG cable from Front-end Motherboard.
17. Disconnect IUP cable from Front-end Motherboard.
18. Disconnect two red Pneumatics tubes from Front-bezel NIBP connector.
19. Disconnect 10-conductor Keypad-to-Volume ribbon cable from Volume board connector.
20. Remove screw fastening Display mounting bracket to front bezel.
21. Remove screw fastening bracket to Display assembly.
22. Remove four screws fastening Display assembly to front bezel.
23. Remove Display assembly.
24. Remove Display lens.
25. Remove four screws fastening Volume board and side keyboard pad to front bezel.
26. Remove Volume board and side keyboard pad.
27. Disconnect Encoder cable from Keypad board.
28. Remove Trim knob, Encoder washer and Encoder.
29. Remove two screws fastening Keypad bracket to front bezel.
30. Remove Keypad bracket.
31. Remove four screws fastening Keypad to front bezel.
32. Remove Keypad board and main keyboard pad.
33. Disconnect four Fast-on tab connectors from power switch.
34. Remove metal retaining clip from power switch.
35. Push power switch out through front bezel.

36. Remove front bezel from chassis tabs.
37. Insert new front bezel into chassis tabs.
38. Push power switch in through front bezel.
39. Insert metal retaining clip into top and bottom bridges on power switch. Then push in tightly.
40. Connect four Fast-on tab connectors to power switch.
41. Insert Encoder, Encoder washer, and Trim knob into front bezel.
42. Insert Keypad board and main keyboard pad into front bezel.
43. Fasten Keypad to front bezel with four screws.
44. Connect Encoder cable to Keypad board.
45. Fasten Keypad bracket to front bezel with two screws.
46. Insert Volume board and side keyboard pad into front bezel.
47. Fasten Volume board and side keyboard pad to front bezel with four screws.
48. Insert new Display lens.
49. Insert new Display assembly. Fasten to front bezel with four screws.
50. Fasten bracket to Display assembly with screw.
51. Fasten bracket to front bezel with screw.
52. Connect 10-conductor Keypad-to-Volume ribbon cable to Volume board connector.
53. Connect red tubes to Front-bezel NIBP connector.
54. Connect IUP cable to Front-end Motherboard.
55. Connect FECG cable to Front-end Motherboard.
56. Place FECG ground cable onto chassis post and tighten with nut.
57. Insert MECG and FECG cable beads into chassis bead clips.
58. Insert MSpO_2 cable beads into chassis bead clips.
59. Connect MECG cable to MECG board connector.
60. Connect MSpO_2 cable to SpO_2 Carrier board connector.
61. Connect Ultrasound cables to Ultrasound board connectors. The left-most Ultrasound connector US1 cable goes to the rear connector on Ultrasound board, J5.
62. Replace card cage cover. Re-insert screws.
63. Tilt the front bezel back onto chassis. Refasten screws to each side of chassis.
64. Connect 10-conductor DSP-to-Keypad ribbon cable to DSP board connector J5.
65. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
66. Connect 8-conductor Inverter cable to DSP board connector J1.
67. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
68. Slide-on top cover. Re-insert screws.

2025177-023 Keypads

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
7. Remove one flat-head screw from each side of the monitor fastening the front bezel to chassis.
8. Tilt the front bezel forward, away from the chassis.
9. Disconnect 10-conductor Keypad-to-Volume ribbon cable from Volume board connector.
10. Remove screw fastening Display mounting bracket to front bezel.
11. Remove screw fastening bracket to Display assembly.
12. Remove four screws fastening Volume board and side keyboard pad to front bezel.
13. Remove Volume board and side keyboard pad.
14. Disconnect Encoder cable from Keypad board.
15. Remove two screws fastening Keypad bracket to front bezel.
16. Remove Keypad bracket.
17. Remove four screws fastening Keypad to front bezel.
18. Remove Keypad board and main keyboard pad.
19. Insert new Keypad board and main keyboard pad into front bezel.
20. Fasten Keypad to front bezel with four screws.
21. Connect Encoder cable to UI Keypad board.
22. Fasten Keypad bracket to front bezel with two screws.
23. Insert new Volume board and side keyboard pad into front bezel.
24. Fasten Volume board and side keyboard pad to front bezel with four screws.
25. Fasten bracket to Display assembly with screw.
26. Fasten bracket to front bezel with screw.
27. Connect 10-conductor UI Keypad-to-Volume ribbon cable to Volume board connector.
28. Tilt the front bezel back onto chassis. Refasten screws to each side of chassis.
29. Connect 10-conductor DSP-to-Keypad ribbon cable to DSP board connector J5.
30. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.

31. Connect 8-conductor Inverter cable to DSP board connector J1.
32. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
33. Slide-on top cover. Re-insert screws.

2025177-026 Trim Knob and Encoder

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
7. Remove one flat-head screw from each side of the monitor fastening the front bezel to chassis.
8. Tilt the front bezel forward, away from the chassis.
9. Disconnect 10-conductor Keypad-to-Volume ribbon cable from Volume board connector.
10. Disconnect Encoder cable from Keypad board.
11. Remove Trim Knob, Encoder washer and Encoder.
12. Insert new Encoder, Encoder washer, and Trim Knob.
13. Connect Encoder cable to Keypad board.
14. Fasten Keypad bracket to front bezel with two screws.
15. Insert new Volume board and side keyboard pad into front bezel.
16. Fasten Volume board and side keyboard pad to front bezel with four screws.
17. Fasten bracket to Display assembly with screw.
18. Fasten bracket to front bezel with screw.
19. Connect 10-conductor Keypad-to-Volume ribbon cable to Volume board connector.
20. Tilt the front bezel back onto chassis. Refasten screws to each side of chassis.
21. Connect 10-conductor DSP-to-Keypad ribbon cable to DSP board connector J5.
22. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
23. Connect 8-conductor Inverter cable to DSP board connector J1.
24. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
25. Slide-on top cover. Re-insert screws.

2025177-027 Power Switch Assembly

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
7. Remove one flat-head screw from each side of the monitor fastening the front bezel to chassis.
8. Tilt the front bezel forward, away from the chassis.
9. Disconnect power-switch cable from power supply bulkhead-mounted connector.
10. Disconnect four Fast-on tab connectors from power switch.
11. Remove metal retaining clip from power switch.
12. Push power switch out through front bezel.
13. Connect power-switch cable to power supply bulkhead-mounted connector.
14. Push power switch in through front bezel.
15. Insert metal retaining clip into top and bottom bridges on power switch. Then push in tightly.
16. Connect four Fast-on tab connectors to power switch.
17. Tilt the front bezel back onto chassis. Refasten screws to each side of chassis.
18. Connect 10-conductor DSP-to-Keypad ribbon cable to DSP board connector J5.
19. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
20. Connect 8-conductor Inverter cable to DSP board connector J1.
21. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
22. Slide-on top cover. Re-insert screws.

2025177-028 Main Power Supply

1. Remove top cover. Keep screws aside.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.

6. Disconnect 10-conductor DSP-to-Keypad ribbon cable from DSP board connector J5.
7. Remove two screws fastening Pneumatics assembly to chassis.
8. Remove clear section of tubing from E1 to PT1 on Main board.
9. Remove clear section of tubing from E2 to PT2 on Main board.
10. Remove Pneumatics assembly. Leave tubing connected to Front Bezel. The tubing length should be sufficient.
11. Cut tie-wrap holding power-switch cable to cable-tie mount on chassis.
12. Disconnect power-switch cable from power supply bulkhead-mounted connector.
13. Remove power supply bulkhead-mounted connector from chassis with needle-nose pliers.
14. Disconnect Power Supply cable from J1 connector on Recorder board. Slide grommet out of bulkhead.
15. Disconnect Power Supply cable from J8 connector on Main board. Slide grommet out of bulkhead.
16. Remove three flat-head screws from side of Power Supply. (See photograph below.)
17. Remove four pan-head screws from back of Power Supply.
18. Remove one pan-head screw from inside bottom of Power Supply. (See photograph below.)
19. Unplug Fan from Power Supply.
20. Remove Power Supply from chassis.
21. Replace with new Power Supply.
22. Fasten three flat-head screws into side of Power Supply.
23. Fasten four pan-head screws into back of Power Supply.
24. Fasten one pan-head screw into inside bottom of Power Supply.
25. Connect Power Supply cable to J1 connector on Recorder board.
26. Connect Power Supply cable to J8 connector on Main board.
27. Insert power supply power-switch connector into chassis.
28. Connect front-bezel power-switch cable to chassis-mounted connector.
29. Adhere new cable tie mount to side of chassis.
30. Use tie-wrap to fasten power-switch cable to cable-tie mount on chassis.
31. Replace Pneumatics assembly onto Main board.
32. Connect clear section of tubing from E1 to PT1 on Main board.
33. Connect clear section of tubing from E2 to PT2 on Main board.
34. Fasten Pneumatics assembly to chassis with two screws.
35. Connect 8-conductor Inverter cable to DSP board connector J1.

36. Connect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
37. Connect 10-conductor DSP-to-Keypad ribbon cable to DSP board connector J5.
38. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
39. Replace top cover. Re-insert screws.

2025177-029 MECG Board

1. Remove top cover.
2. Remove two screws fastening DSP board to chassis.
3. Remove DSP board from Main board.
4. Disconnect 8-conductor Inverter cable from DSP board connector J1.
5. Disconnect 20-conductor DSP-to-LCD Decoder ribbon cable from DSP board connector J2.
6. Remove card cage cover.
7. Disconnect MECG cable from MECG board connector.
8. Remove MECG/FECG assembly from Front-end Motherboard.
9. Remove two screws fastening MECG board to FECG board.
10. Remove MECG board from FECG board.
11. Insert new MECG board onto FECG board and fasten with two screws.
12. Insert MECG and FECG boards into Front-End Motherboard.
13. Connect MECG cable to MECG board connector.
14. Replace card cage cover. Re-insert screws.
15. Reconnect 8-conductor Inverter cable to DSP board connector J1.
16. Reconnect 20-conductor DSP-to-LCD Decoder ribbon cable to DSP board connector J2.
17. Place DSP board onto Main board. Use two screws to fasten DSP board to chassis.
18. Place top cover. Re-insert screws.

2025177-031 Top Cover Gasket

1. Remove top cover. Remove the gasket on the inside front edge by pulling it free of the cover.
2. Clean the stamping area where the gasket was adhered to the cover by wiping the surface with isopropyl alcohol.
3. Align the front edge of the gasket along the stamping line on the inside of the top cover and apply pressure to secure it. Ensure the adhesive of the gasket is completely sealed all along the stamping line.

CAUTION

The top cover gasket protects the inside of the unit from fluid spills. Whenever the monitor cover is removed during servicing, be sure to inspect the gasket, ensuring it is attached securely across the whole front of the top cover along the stamping line (just in from the edge). If the adhesive is no longer effective, order replacement Top Cover Gasket FRU 2025177-031.

A Technical Specifications

This section contains a detailed list of the technical specifications for the 250 Series Monitor.

For your notes

General Monitor

Table 1. General Monitor Technical Specifications					
Category	**Technical Specifications**				
Power Requirements					
Nominal Line Voltage:	100VAC	120 VAC	220 VAC	230 VAC	240 VAC
Line Frequency:	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Power Consumption (maximum):	100 W	100 W	0.4 A	0.4 A	0.4 A
Chassis Leakage:	<300 µA				
Physical Characteristics					
Height:	6.7 in (17.0 cm)				
Width:	16.7 in (42.4 cm)				
Depth:	17.5 in (44.4 cm)				
Weight:	22.0 lbs (10.9 kg) approx.				
Environmental Conditions	**Operating**		**Storage**		
Monitor:					
Ambient Temperature:	50°F to 104°F (10°C to 40°C)		14°F to 131°F (–10°C to 55°C)		
Relative Humidity:	10% to 95%, non-condensing		0% to 95%, non-condensing		
Atmospheric Pressure:	700–1060 mbar (525–795 mmHg)		700–1060 mbar (525–795 mmHg)		
Strip Chart Paper[1]:					
Ambient Temperature:	50°F to 104°F (10°C to 40°C)		< 80°F (< 26.5°C)		
Relative Humidity:	30% to 70%, non-condensing		45% to 65%, non-condensing		
Atmospheric Pressure:	700–1060 mbar (525–795 mmHg)		700–1060 mbar (525–795 mmHg)		
Certification					
ANSI/AAMI EC13-1992:	Complies with all areas except those listed below: 3.1.2.1e: Heart Rate Meter Accuracy and Response to Irregular Rhythm (not tested) 3.2.6.1: Range of QRS wave amplitude and duration 3.2.7: Range and accuracy of heart rate meter (4.2.7 f: input rate of 300 bpm.) 3.2.8.1: Lower Alarm Limit (The lowest alarm limit on the 250 Series is 35 bpm.) 3.2.9.7a: Output Display a) Channel Width 3.2.9.8c: Impulse Response 3.2.9.12: Pacemaker Pulse Display capability				
UL-2601.1:	Classified to UL-2601.1 Medical electrical equipment classified by Underwriter's Laboratories, Inc., with respect to fire, shock, and mechanical hazards in accordance with UL-2601.1.				
CUL:	Classified with respect to electric shock, fire, mechanical, and other specified hazards only, in accordance with CAN/CSA C22.2 No. 601.1				

[1] Paper operating environmental conditions are for a period of less than one month. Paper storage environmental conditions are for extended storage.

Operating Modes

Table 2. Operating Mode Specifications

CAUTION
The monitor may produce incorrect results if operated outside the minimum specified parameter specifications in this table.

FECG Mode	
Technique:	Peak detecting, beat-to-beat cardiotachometer
Heart Rate Counting Range:	30–240 bpm
Heart Rate Resolution:	± 1 bpm
Artifact Elimination:	Selectable, ± 25 bpm artifact rejection
Countable Input Signal Range:	15 µV to 2 mV peak-to-peak
Offset Voltage Tolerance (Differential):	± 300 mVdc maximum
Maximum Common Mode Voltage:	20 V peak-to-peak
Preamplifier Bandwidth:	1–90 Hz
Common Mode Rejection:	
Balanced:	> 120 dB at mains frequency, with patient cable
Unbalanced 5kΩ RA or LA:	> 110 dB at mains frequency
Input Equivalent Noise:	< 10 µV peak-to-peak
Input Impedance:	
Differential:	> 10 MΩ
Common Mode:	> 20 MΩ
Mains Frequency Rejection:	> 40 dB
Leakage Current:	< 60 µA at 254 VAC, electrically isolated
Isolation, Mains-to-Patient:	> 4 kVAC
Ultrasound Mode	
Technique:	Pulsed Doppler with autocorrelation processing
Transducer Type:	9-crystal
Pulse Repetition Frequency:	
Single Ultrasound Mode:	4 kHz
Dual Ultrasound Mode:	2 kHz
Pulse Duration:	92 µs
Transmitter Frequency:	1.151 MHz
Spatial-Peak Temporal Average Intensity:	Ispta < 10 mW/cm^2
Spatial-Average Temporal Average Intensity:	Isata< 5 mW/cm^2
Focal 20 dB Beam Area:	16.6 cm^2, at a range = 7 cm
Peak Instantaneous Intensity:	1.8 mW/cm^2
Peak-Negative Acoustic Pressure:	p < 10.0 kPa
Heart Rate Counting Range:	50–210 bpm
Leakage Current:	< 10 µA at 120–240 VAC, isolated by transducer

Uterine Activity Mode	**Strain Gauge**	**Tocotransducer**
Range:[1]	0–100 mmHg (0–13.3 kPa)	0–100 mmHg (0–13.3 kPa)
Resolution:	1 mmHg (0.13 kPa)	1 mmHg (0.13 kPa)
Bandwidth:	dc to 0.5 Hz	dc to 0.5 Hz
Excitation Voltage:	+4.0 Vdc	
Zero Set Temperature Drift:	< 0.1 mmHg/°C (0.013 kPa/°C), excluding transducer	
Leakage Current:	< 60 µA at 254 VAC, electrically isolated	

[1]The ranges shown here are typical ranges seen in a clinical setting.

Table 2. Operating Mode Specifications (Continued)	
MECG Mode	
Technique:	Peak detecting, beat-to-beat cardiotachometer
Maternal ECG Electrode Type:	Medtronic 1700-003 or equivalent
Leads Available:	I, II, and III
Heart Rate Counting Range:	30–240 bpm
Heart Rate Resolution:	± 1 bpm
Heart Rate Averaging:	1-second average
Heart Rate Update Rate:	> 1 update per second
Countable Input Signal Range:	0.5 mV to 5 mV peak-to-peak
Baseline Drift:	< 0.5 mV RTI
Tall T-wave Rejection:	0.8 **x** QRS amplitude
Heart Rate Meter Response Time:	
80–120 bpm Step Increase:	< 2 seconds
80–40 bpm Step Decrease:	< 3 seconds
Alarm Time for Tachycardia 80–200 bpm:	< 10 seconds (high alarm limit at 100 bpm)
Offset Voltage Tolerance (Differential):	± 300 mVdc maximum
Maximum Common Mode Voltage:	20 V peak-to-peak
Preamplifier Bandwidth:	0.6 to 40 Hz
Common Mode Rejection:	
Balanced:	> 80 dB at mains frequency, with patient cable
Unbalanced 5K RA or LA:	> 50 dB at mains frequency
Input Equivalent Noise: Input Impedance:	< 30 µV peak-to-peak
Differential:	> 2.5 MΩ
Common Mode:	> 10 MΩ
Mains Frequency Rejection:	> 40 dB
Leakage Current:	< 60 µA at 254 VAC, with cable, electrically isolated
Isolation, Mains-to-Patient:	> 4 kVAC
Leads Off Detection:	dc current < 0.1 µA
Alarms:	
Audio:	Alternating 1.5-second chimes
Visual:	Flashing heart rate numeric or message
Limits:	User-selectable high and low maternal heart rate
Technical:	Leads off
Tachycardia Response Time:	< 8 seconds
Pacemaker Detection/Rejection:	
Input Voltage Range:	± 2.5 mV to ± 700mV
Input Pulse Width:	0.1 to 2 ms
Pulse Rise/Fall Time:	< 10% of pulse width; not greater than 100 µs
Overshoot/Undershoot:	2 mV

CAUTION
Excessive overshoot time of pacemaker pulse may cause false QRS detection.

Table 2. Operating Mode Specifications (Continued)	
Maternal Blood Pressure Mode (DINAMAP® SuperSTAT) Technique:	Oscillometric. Microprocessor software eliminates most ambient noise and motion artifact.
Blood Pressure Range: Systolic Diastolic Visual Mean Arterial Pressure (MAP)	30–290 mmHg (4.0–38.7 kPa) 10–220 mmHg (1.3–29.3 kPa) 20–260 mmHg (2.7–34.7 kPa)
Pulse Rate Range:	30–200 bpm
Blood Pressure Accuracy:	± 5 mmHg (0.7 kPa) with a standard deviation no greater than 8 mmHg (1.1 kPa)
Pulse Rate Accuracy:	± 2 bpm or ± 2% (whichever is greater)
Cuff Inflation:	Initial inflation to 135 mmHg (18.0 kPa). Subsequent inflation approximately 30 mmHg (4.0 kPa) greater than the previous systolic pressure.
Inflation Pressure Range:	100-250 mmHg in increments of 5 (13.3 ± 33.3 kPa in steps of 0.7)
Cuff Deflation:	Automatic
Safety Features:	Automatic cuff deflation if: cuff pressure exceeds the overpressure limit of 315 mmHg ± 15 mmHg (42.0 ± 2.0 kPa); or maximum reading determination time is exceeded (not to exceed AAMI /ANSI SP10-1992 limit of 180 s); or safety timer detects microprocessor failure. Auto mode minimum 30-second delay from the end of one determination to the beginning of another to allow for venous return.
Display/Record:	Systolic, diastolic, and mean pressure; pulse rate
Alarms: Audio Visual Limits Technical	 Alternating 1.5-second chimes Flashing pressure numeric or message User-selectable high and low systolic, diastolic, and mean pressures; User-selectable high and low pulse rate Cuff errors, connection errors, insufficient signal, excessive inflation or determination times, overpressure, hose errors, excessive motion, communication problem, or self-test failure.
Compliance:	The 250 Series blood pressure parameter complies with the American National Standard for Electronic or Automated Sphygmomanometers [AAMI/ANSI SP10-1992]. The GE monitor values are based on the oscillometric method of noninvasive blood pressure measurement and correspond to comparisons with intra-aortic values within ANSI/AAMI Standards for accuracy.
This device is covered under one or more of the following US Patents: 6,423,010; 6,358,213; 5,704,362; 5,680,870; 5,579,776; 5,518,000; 5,170,795; 5,052,397; 4,754,761; 4,638,810 and international equivalents. USA patents pending.	

Table 2. Operating Mode Specifications (Continued)	
Maternal Pulse Oximetry Mode (Masimo)	
Technique:	Spectrophotometry and plethysmography.
Sensor Accuracy[1]:	
Sensor Model	LNOP® DC-I, LNOP-Adt, LNCS PC-I, and LNCS-Adt
Weight Range	> 30 kg
Saturation No Motion	± 2%
Accuracy Motion	± 3%
Pulse Rate No Motion	± 3 bpm
Accuracy Motion	± 5 bpm
Low Perfusion Saturation	± 2%
Accuracy Pulse Rate	± 3 bpm
Measurement Range:	
Saturation Range (SpO_2%)	1%-100%
Pulse Rate (bpm)	25-240 beats/min
Perfusion	0.02%-20%
Accuracy and Motion Tolerance:	
Saturation (SpO_2%)	
During no motion conditions - Adults[2]	70%-100% ± 2 digits
During motion conditions - Adults[3]	70%-100% ± 3 digits
Low Perfusion	70%-100% ± 2 digits 0%-69% unspecified
Wavelengths:	
Red	663 nm, nominal
Infrared	880 nm, nominal
Maximum Optical Output Power:	
Radiant Power at 50 mA pulsed	0.13 mW, minimum 0.79 mW, maximum
Pulse Rate (bpm)	
During no motion conditions - Adults	25 to 240 bpm ± 3 digits
During motion conditions - Adults	25 to 240 bpm ± 5 digits
Resolution:	
Saturation (SpO_2%)	1%
Pulse Rate (bpm)	1
Low Perfusion Performance[4]:	
>0.02% Pulse Amplitude and % Transmission > 5%	Saturation (SpO_2%) ± 2 digits Pulse Rate ± 3 digits
Alarms:	
Visual	Flashing SpO_2 numerics or message
Audio	Alternating 1.5-second chimes
Interfering Substances	Carboxyhemoglobin may erroneously increase readings. The level of increase is approximately equal to the amount of carboxyhemoglobin present. Dyes, or any substance containing dyes, that change usual arterial pigmentation may cause erroneous readings.

Table 2. Operating Mode Specifications (Continued)	
Maternal Pulse Oximetry Mode (Masimo continued)	

[1] Accuracy specified when used with Masimo SET pulse oximetry modules using PC or LNC series patient cables. Numbers represent ± 1 standard deviation.Plus or minus one standard deviation represents 68% of the population.SpO_2 accuracy from 70% to 100%.Pulse Rate accuracy from 25 to 240 bpm.

[2]The Masimo SET® SpO_2 parameter with LNOP-Adt sensors has been validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70-100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

[3]The Masimo SET SpO_2 parameter with LNOP-Adt sensors has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz at an amplitude of 1 to 2 cm and a non repetitive motion before 1 to 5 Hz at an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70-100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population. Masimo SET technology with LNOP and LNCS sensors have been validated with human blood studies on healthy adult volunteers with induced hypoxia studies. The volunteer population composed of both men and women spanned a range of skin pigmentations from light to dark and ranged in age from 22 to 40 years old.

[4]The Masimo SET SpO_2 parameter has been validated for low perfusion accuracy in bench top testing against a Biotek Index 2 simulator and Masimo's simulator with signal strengths of greater than 0.02% and a % transmission of greater than 5% for saturations ranging from 70 to 100%. This variation equals plus or minus, one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

NOTE: Because pulse oximeter equipment measurements are statistically distributed, only about two-thirds of pulse oximeter equipment measurements can be expected to fall within ± A_{rms} of the value measured by a CO-Oximeter.

NOTE: Use of a functional SpO_2 simulator to assess the accuracy of the Corometrics 250 SpO_2 parameter has not been demonstrated.

This device is covered under one or more of the following US Patents: 5,482,036;5,490,505;5,632,272;5,685,299; 5,758,644; 5,769,785; 6,002,952; 6,036,642; 6,067,462; 6,206,830; 6,157,850 and international equivalents. USA and international patents pending.

Table 2. Operating Mode Specifications (Continued)	
Maternal Pulse Oximetry Mode (Ohmeda)	
Technique:	Spectrophotometry and plethysmography
Sensor Type[1]:	OxiTip+ OXY-AP and OxiTip+ OXY-F
Pulse Rate Accuracy:	30-250 bpm; ± 2 digits or ± 2%, whichever is greater (no motion) 30-250 bpm; ± 5 digits or ± 5%, whichever is greater (with motion) 30-250 bpm; ± 3 digits or ± 3%, whichever is greater (during low perfusion)
Saturation Range:	0-100%
Pulse Rate Range:	30-250 bpm
Saturation Accuracy:[2]	Accuracy, A_{rms} (root mean square of paired values; previously represented by ± 1 standard deviation) 70-100% ± 2 digits (without motion) 70-100% ± 3 digits (during clinical motion)[1] 70-100% ± 2 digits (during clinical low perfusion) Below 70% unspecified
Wavelengths:	
Red	650-670 nm
Infrared	930-950 nm
Maximum Optical Output Power:	10.5 mW
Alarms: (audio and visual)	
Audio	Alternating 1.5-second chimes
Visual	Flashing SpO_2 numeric or message
Limits	User-selectable high and low SpO_2, and high and low pulse rate
Technical	Sensor errors, connection errors, insufficient signal, excessive motion, communication problem, internal calibration error, or self-test failure.

[1] Applicability: OxyTip+ Adult/Pediatric. Accuracy of Oxy-F sensors has not been validated under clinical motion conditions. Ohmeda sensor accuracy tests were done with 13 healthy adult subjects. The volunteer population was composed of 3 females and 10 males. The ages ranged from 19 to 35 years old. The weights ranged from 120 to 185 lb with a mean weight of 158 lb. The skin tones were as follows: 2 African-American and Jamaican subjects with dark pigmentation, 1 Asian subject with light yellow pigmentation, 1 Hispanic subject and 1 Mexican subject with medium pigmentation, and 8 Caucasian subjects with light to medium pigmentation. OxyTip+ OXY- AP sensor has been validated under motion condition. Three types of motion artifacts were evaluated: mechanically induced tapping at 3 Hz, random frequency clinical rubbing motion with hand in prone position, and random frequency clinical rubbing motion with hand in supine position.

[2] OxyTip+ sensors are validated during low perfusion conditions. Low perfusion was achieved by having the room chilled to 60-68º F, keeping the left side of the subject warm and the right side cooled to a perfusion index level <= 0.1. Saturation readings were compared against a reference system that was compared to arterial blood draws.

NOTE: Because pulse oximeter equipment measurements are statistically distributed, only about two-thirds of pulse oximeter equipment measurements can be expected to fall within ± A_{rms} of the value measured by a CO-Oximeter.

NOTE: Use of a functional SpO_2 simulator to assess the accuracy of the Corometrics 250 SpO_2 parameter has not been demonstrated.

This device is covered under one or more of the following US Patents: 5,503,148, 5,766,127, 5,934,277, 6,381,479, 6,385,471, 6,397,092, 6,408,198, 6,415,166, 6,434,408, 6,505,060, 6,505,133, 6,510,329, 6,650,918, 6,707,257, 6,714,803.

Table 2. Operating Mode Specifications (Continued)	
Maternal Pulse Oximetry Mode (Nellcor)	
Technique:	Spectrophotometry and plethysmography.
Sensor Type and Accuracy[1]:	SpO2 Range:
OxiMax® Sensor Models	70%–100%:
MAX-A[2],	± 2 digits
DS-100A	± 3 digits
Saturation Range:	1–100%
Pulse Rate Range:	30–250 bpm
Accuracy:	
Saturation (SpO_2%)	
Adults[2]	70%-100% ± 2 digits
Low Perfusion[3]	70%-100% ± 2 digits 0%-69% unspecified
Pulse Rate (bpm)	
Adults	20 to 250 bpm ± 3 digits
Wavelengths[4]:	
Red	660 nm, nominal
Infrared	890 nm, nominal
Maximum Optical Output Power:	< 15 mW
Response Time:	Fast
Alarms (audible and visual):	Alternating 1.5-second chimes
Audio	Flashing SpO_2 numeric or message
Visual	User-selectable high and low SpO_2; User-selectable high and low pulse rate
Limits	Sensor errors, connection errors, insufficient signal, communication problem, internal calibration error, or self-test failure.
Technical	

[1] Accuracy specifications are based on controlled hypoxia studies with healthy, non-smoking adult volunteers over the specified saturation SpO_2 range. Pulse oximeter SpO_2 readings were compared to SaO_2 values of drawn blood samples measured by hemoximetry. All accuracies are expressed as ± "X" digits. This variation equals ± one standard deviation (± 1 SD), which encompasses 68%of the population.Oxygen saturation accuracy can be affected by certain environmental and patient physiological conditions, as discussed in the operator's manual for the monitor. Use Nellcor sensors only with 250 Series Monitors containing Nellcor oximetry. Consult individual manufacturers for accuracy specifications and compatibility information of particular instruments and Nellcor sensor models. The volunteer population was composed of healthy men and women recruited from the local population. The ages ranged from 18 to 50 years old, with variations of skin pigmentations.

[2] Adult specifications are shown for OxiMax®MAX-A and MAX-N sensors with the N-600. Saturation accuracy will vary by sensor type.

[3] Applicability: OxiMax® MAX-A, MAX-AL, MAX-P, MAX-I, and MAX-N sensors.

[4] Information of wavelength range can be especially useful to clinicians performing photodynamic therapy.

NOTE: Because pulse oximeter equipment measurements are statistically distributed, only about two-thirds of pulse oximeter equipment measurements can be expected to fall within ± A_{rms} of the value measured by a CO-Oximeter.

NOTE: Use of a functional SpO_2 simulator to assess the accuracy of the Corometrics 250 SpO_2 parameter has not been demonstrated.

This device is covered under one or more of the following Patents: US Patent No. 4,802,486; 4,869,254; 4,928,692; 4,934,372; 4,960,126; 5,078,136; 5,485,847; 5,743,263; 5,865,736; 6,035,223; 6,298,252; 6,463,310; 6,591,123; 6,675,031; 6,708,049; 6,801,797; Re. 35,122; and foreign equivalents.

Maternal Vital Signs History	
Storage/Recall:	8 hours, maximum

Strip Chart Recorder

Table 3. Strip Chart Recorder Technical Specifications		
Heart Rate Scale	**Domestic**	**International**
Chart Width:	7 cm	8 cm
Scaling:	30 bpm/cm	20 bpm/cm
Range:	30–240 bpm	50–210 bpm
Resolution:	1 bpm	1 bpm
Uterine Activity Scale	**Strain Gauge**	**Tocotransducer**
Chart Width:	4 cm	4 cm
Scaling:	25 mmHg (3.3 kPa)/cm	25 mmHg (3.3 kPa)/cm
Range:	0–100 mmHg (0–13.3 kPa)	0–100 mmHg (0–13.3 kPa)
Resolution:	1 mmHg/kPa	1 mmHg/kPa
Maternal Pulse Oximetry $MSpO_2$ Scale	**Domestic**	**International**
Chart Width:	4 cm	4 cm
Scaling:	12.5%/cm or 25%/cm	12.5%/cm or 25%/cm
Range:	60–100% or 0–100%	50–100% or 0–100%
Resolution:	1%	1%
Recorder Drive		
Speeds:	1, 2, and 3 cm/min	
Speed Accuracy:	± 1%	

NOTE: Specifications are subject to change without notice.

B Alarms Summary

For your notes

Table B-1. Summary of 250 Series Alarms			
Type	**Condition**	**Visible Advisory**	**Audible Advisory**
FHR	An alarm setting (audio or high/low limit) is turned off. Alarm Defaults Audio: on Volume: 5 Limits: High = 160 bpm, Low = 120 bpm	displays to the left of the FHR mode title.	—
	FHR limit (high or low) actively being violated. or Unsilenced, resolved FHR limit violation (the limit was violated but the FHR has since returned to the normal range before clinical acknowledgement). For continuous limit violations: a high alarm activates after 5 minutes; a low alarm activates after 30 seconds. **About Latching Alarms:** The FHR limit alarms are latching alarms which means that a clinician must acknowledge the alarm using the monitor's **Alarm Silence** button in order to clear the alarm.	FHR numeric flashes.	Alternating high/low tones (if audio enabled).
	Inadequate FHR signal quality.	Flashing dashes "– – –" in place of FHR numeric.	Alternating high/low tones (if audio enabled).
NIBP	Systolic, diastolic, or MAP pressure value (high or low) actively being violated.	NIBP numeric (systolic, diastolic, or MAP) flashes.	Alternating high/low tones (if audio enabled).
	Malfunction with NIBP circuitry, cuff, or air hoses.	*CHECK CUFF*, *LEAK*, *COMM, MOTION*, *WEAK SIGNAL*, or *REPAIR* message displays in *NIBP* area.	Alternating high/low tones (if audio enabled).

Table B-1. Summary of 250 Series Alarms			
Type	**Condition**	**Visible Advisory**	**Audible Advisory**
MHR/P[1]	Alarm Defaults Audio: on Volume: 5 Limits: High = 120 bpm, Low = 50 bpm Re-alarm: 120 sec		—
	MHR/P limit (high or low) actively being violated.	MHR/P numeric flashes.	Alternating high/low tones (if audio enabled).
	The tachycardia response time is < 8 seconds.		
	Asystole.	Flashing dashes "– – –" in place of MHR/P numeric.	Alternating high/low tones (if audio enabled).
	MECG leads off.	Flashing dashes "– – –" in place of MHR/P numeric and *MECG LEADS OFF* message displays underneath.	Alternating high/low tones (if audio enabled).
[1] There is an MECG re-alarm.			
$MSpO_2$	Alarm Defaults Audio: on Volume: 5 Limits: High = 100%, Low = 95% Re-alarm: 120 sec		—
	$MSpO_2$ limit (high or low) actively being violated. Issued after about 8 seconds.	$MSpO_2$ numeric flashes. $MSpO_2$ value and pulse rate print on the strip chart.	Alternating high/low tones (if audio enabled).
	Malfunction with $MSpO_2$ circuitry.	*COMM* or *REPAIR* message displays in $MSpO_2$ area.	Alternating high/low tones (if audio enabled).
	$MSpO_2$ intermediate cable disconnected from monitor; sensor assembly disconnected from intermediate cable; or sensor or cable has a broken wire.	Dashes "– – –" in place of $MSpO_2$ numeric.	Alternating high/low tones (if audio enabled).

NOTE: For further information on Alarms, refer to Chapter 11 in the Corometrics 250 Series Operator's Manual.

C Electromagnetic Compatibility

For your notes

Electromagnetic Compatibility (EMC)

Changes or modifications to this system not expressly approved by GE Medical Systems can cause EMC issues with this or other equipment. This system is designed and tested to comply with applicable regulation regarding EMC and must be installed and put into service according to the EMC information stated in this appendix.

WARNINGS

Use of portable phones or other radio frequency (RF) emitting equipment near the system may cause unexpected or adverse operation.

The equipment or system should not be used adjacent to, or stacked with, other equipment. If adjacent or stacked use is necessary, the equipment or system should be tested to verify normal operation in the configuration in which it is being used.

Guidance and Manufacturer's Declaration – Electromagnetic Emissions

The Corometrics 250 Series Maternal/Fetal Monitor is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or user to assure that the 250 Series Maternal/Fetal Monitor is used in such an environment.

Emissions Test	Compliance	Electromagnetic Environment – Guidance
RF Emissions EN 55011	Group 1	The equipment uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF Emissions EN 55011	Class A	The equipment is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions EN 61000-3-2	Class A	
Voltage Fluctuations/ Flicker Emissions EN 61000-3-3	Complies	

Guidance and Manufacturer's Declaration – Electromagnetic Immunity

The 250 Series Maternal/Fetal Monitor is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or user to assure that the 250 Series Maternal/Fetal Monitor is used in such an environment.

Immunity Test	EN 60601 Test Level	Compliance Level	Electromagnetic Environment – Guidance
Electrostatic Discharge (ESD) EN 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical Fast Transient/Burst EN 61000-4-4	± 2 kV for power supply lines ±1 kV for input/output lines	± 2 kV for power supply lines ±1 kV for input/output lines	Mains power should be that of a typical commercial or hospital environment.
Surge EN 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines EN 61000-4-11	<5% U_t (>95% dip in U_t) for 0.5 cycles <40% U_t (>60% dip in U_t) for 5 cycles <70% U_t (>30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5 s	<5% U_t (>95% dip in U_t) for 0.5 cycles <40% U_t (>60% dip in U_t) for 5 cycles <70% U_t (>30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5 s	Mains power should be that of a typical commercial or hospital environment. If the user of the equipment requires continued operation during power mains interruptions, it is recommended that the equipment be powered from an uninterruptible power supply or a battery.
Power Frequency (50/60 Hz) Magnetic Field EN 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristics of a typical location in a typical commercial or hospital environment.

NOTE:

U_t is the AC mains voltage prior to application of the test level.

Guidance and Manufacturer's Declaration – Electromagnetic Immunity

The 250 Series Maternal/Fetal Monitor is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or user to assure that the 250 Series Maternal/Fetal Monitor is used in such an environment.

Immunity Test	EN 60601 Test Level	Compliance Level	Electromagnetic Environment – Guidance
			Portable and mobile RF communications equipment should not be used closer to any part of the equipment, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance**
Conducted RF EN 61000-4-6	3 Vrms 150 KHz to 80 MHz	3 Vrms	$d = 1.2\sqrt{P}$
Radiated RF EN 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer, and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a], should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol:

NOTE 1: At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by reflection from structures, objects, and people.

[a]Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the equipment is used exceeds the applicable RF compliance level above, the equipment should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the equipment.

[b]Over the frequency range 150 KHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended Separation Distances

The table below provides the recommended separation distances (in meters) between portable and mobile RF communications equipment and the 250 Series Maternal/Fetal Monitor.

The 250 Series Maternal/Fetal Monitor is intended for use in the electromagnetic environment on which radiated RF disturbances are controlled. The customer or the user of the 250 Series Maternal/Fetal Monitor can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the 250 Series Maternal/Fetal Monitor as recommended below, according to the maximum output power of the communications equipment.

	Separation Distance in Meters (m) According to Frequency of Transmitter		
Rated Maximum Output Power of Transmitter in Watts	**150 kHz to 80 MHz** [a] $d = 1.2\sqrt{P}$	**80 MHz to 800 MHz** [a] $d = 1.2\sqrt{P}$	**800 MHz to 2.5 GHz** [a] $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23
[a]At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.			

For transmitters rated at a maximum output power not listed above, the recommended separation distance [*d*] in meters (m) can be estimated using the equitation applicable to the frequency of the transmitter, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE:

These guidelines may not apply in all instances. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Compliant Cables and Accessories

WARNING
The use of accessories, transducers and cables other than those specified may result in increased emissions or decreased immunity performance of the equipment or system.

The table below lists cables, transducers, and other applicable accessories with which GE Medical Systems claims EMC compliance.

NOTE: Any supplied accessories that do not affect EMC compliance are not included.

Part No	Description	Maximum Lengths
ECG Cables		
1442AAO	Y Adapter Cable Maternal/Fetal ECG, Rectangular	.46 m /18 in
1442BAO	FECG Socket Adapter	.46 m /18 in
1553AAO	Multi-Link Cable, 3 Lead ECG Maternal, AHA, Rectangle	3.6 m / 12 ft
1553BAO	Multi-Link Cable, 3 Lead ECG Maternal, IEC, Rectangle	3.6 m /12 ft
1564AAO	120 Recorder Cable MECG	3.6 m / 12 ft
1590AAO	Qwik Connect Plus cable (Round)	2.4 m / 8 ft
1591AAO	Qwik Connect Plus FSE Cable (Leg Plate Cable), Rectangle	2.4 m / 8 ft
412682-001	Leadwire set, AHA Grabber	N/A
412682-003	Leadwire set, IEC Grabber	N/A
7000AAO	Fetal Spiral Electrodes, Qwik Connect Plus	N/A
Intrauterine Pressure Catheters		
2076BAO	Saflex® Intrauterine Pressure Catheter	N/A
1336AAO	Saflex® Intrauterine Pressure Catheter Cable	3.6 m / 12 ft
SpO_2 / Pulse Oximetry Cables and Sensors		
407705-006	Nellcor DuraSensor® Reusable Finger Probe	N/A
2016041-001	Masimo SpO_2 patient adapter cable	3.6 m / 12 ft
OXY-ES3	Ohmeda $MSpO_2$ INTERMED CABLE, 120 SERIES (D-O)	N/A
OXY-F-UN	Ohmeda Finger Sensor	N/A
2017002-003	MASIMO $MSpO_2$ INTERMED CABLE, 120 SERIES	N/A
2002800-001	MASIMO reusable finger sensor	N/A

Part No	Description	Maximum Lengths
2023597-001	MASIMO SET adult reusable finger sensor	N/A
2025350-001	Nellcor MSpO$_2$ INTERMED CABLE, 120 SERIES	N/A
170053	Nellcor OXYGEN XDCRS	N/A
TOCO Cables		
2264HAX	Nautilus Tocotransducer Cable, Loop Style	2.4 m / 8 ft
2264LAX	Nautilus Tocotransducer Cable, Button Style	3 m / 10 ft
Ultrasound Cables		
5700HAX	Nautilus Ultrasound Transducer Cable, Loop Style	2.4 m / 8 ft
5700LAX	Nautilus Ultrasound Transducer Cable, Button Style	3 m / 10 ft
Accessories		
0146AAY	Fetal Acoustic Stimulator (FAST)	2.4 m / 8 ft
1426CAO	Interface cable, HP OBMS / ODIS	1.83m / 6 ft
1426DAO	Interface cable, HP OBMS / ODIS	3.6 m / 12 ft
1558AAO	120 to QS Comm Cable	3 m / 10 ft
1558AAO	120 to QS Comm Cable	3 m / 10 ft
1558BAO	120 to QS Comm Cable	6 m / 20 ft
1562AAO	120/Critikon Interface cable	0.3 m / 1 ft
1562BAO	120/Critikon Interface cable	1.83m / 6 ft
1563AAO	120/340 Interface cable	3 m / 10 ft
1567AAO	120/Traceview Cable, HP Mon to Traceview 120	3 m / 10 ft
1568AAO	120/Traceview Adapter Cable	.36m / 1 ft
1569AAO	120/Peritronics Cable, Cent Surv Intfc Cbl 120	3 m / 10 ft
1580AAO	Cable Assy, 120 to WATCHCHILD	3 m / 10 ft
2007234-001	Cable, Coro – DINAMAP PRO Series	3 m / 10 ft
2116BAX	2116B Data Entry System	N/A
3919BAO	Remote Event Marker	2.4 m / 8 ft
600028	AC cord, Hospital grade, AHA	2.4 m / 8 ft
600034	AC Cord, Hospital Grade, IEC	2.4 m / 8 ft
600049	AC Cord, Hospital Grade, UK	2.4 m / 8 ft
401855-110	AC Cord, Hospital Grade, Australia / New Zealand	2.5m / 8.2ft
919 200 37	Potential Equalization cable	3 m / 10 ft

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